SDMS US EPA Region V

Imagery Insert Form

Document ID: 175148

Some images in this document may be illegible or unavailable in SDMS. Please see reason(s) indicated below:

☐ Illegible due to bad source documents. Image(s) in SDMS is equivalent to hard copy.

Specify Type of Document(s) / Comments:

☒ Includes ____ COLOR or __X__ RESOLUTION variations.
Unless otherwise noted, these images are available in monochrome. The source document page(s) is more legible than the images. The original document is available for viewing at the Superfund Records Center.

Specify Type of Document(s) / Comments:

MOSTLY ON MAPS

☐ Confidential Business Information (CBI).
This document contains highly sensitive information. Due to confidentiality, materials with such information are not available in SDMS. You may contact the EPA Superfund Records Manager if you wish to view this document.

Specify Type of Document(s) / Comments:

☐ Unscannable Material:
Oversized ___ or ____ Format.
Due to certain scanning equipment capability limitations, the document page(s) is not available in SDMS. The original document is available for viewing at the Superfund Records center.

Specify Type of Document(s) / Comments:

☐ Document is available at the EPA Region 5 Records Center.

Specify Type of Document(s) / Comments:

Rev. 07/10/02

175148 0-3

Second Five-Year Review Report

for

Muskegon Chemical Company NPL Site

Whitehall
Muskegon County, Michigan

April 2003

PREPARED BY:

Michigan Department of Environmental Quality
Lansing, Michigan

Approved by:

Wm. E. Muno

William E. Muno
Director, Superfund Division
U.S. Environmental Protection Agency
Region 5

Date:

4/4/03

Five-Year Review Report

Table of Contents

List of Acronyms

1,2-DCA	1,2-dichloroethane
Chlorex	bis (2-chloroethyl) ether
COC	Contaminant of Concern
gpm	Gallons Per Minute
GSI	Groundwater-Surface Water Interface
IRA	Interim Remedial Action
KCC	Koch Chemical Company
kW	Kilowatt
MCC	Muskegon Chemical Company
MDEQ	Michigan Department of Environmental Quality
MDNR	Michigan Department of Natural Resources
NPL	National Priorities List
NREPA	Natural Resources and Environmental Protection Act
PCE	Tetrachloroethylene
POTW	Publicly Owned Treatment Works
RA	Remedial Action
RAG	Remedial Action Goal
RAP	Remedial Action Plan
RD	Remedial Design
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RPM	Remedial Project Manager
SVE	Soil Vacuum Extraction
SVOC	Semi-Volatile Organic Compound
TDL	Target Detection Limit
TCE	Trichloroethylene
TGDC	bis (2-chloroethoxy) ethane
U.S. EPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound

Executive Summary

The former Muskegon Chemical Company (MCC) production facility is located at 1725 Warner Street, on the southern outskirts of Whitehall, Muskegon County, Michigan. The area around the former plant is zoned light industrial. Howmet Corporation owns and operates production facilities on property west of the MCC plant. The land to the north and east is occupied by the Whitehall Industrial Park. The land south of the plant is owned by CSX Corporation, and to the south of that are Whitehall Department of Public Works facilities.

Table 1, within this report, lists an extensive site chronology. In summary, the MCC plant began producing specialty chemicals in 1975. In 1977 it was discovered that process chemicals had leaked from a floor drain and sump system and contaminated the local water table aquifer near the plant. Later investigations tracked the groundwater contaminant plume approximately one-half mile south southwest to its discharge point in Mill Pond Creek.

The MCC site was added to the National Priorities List (NPL) in 1990. The remedy, chosen in 1997, included groundwater extraction and treatment, thermally enhanced soil vacuum extraction (SVE) and air sparging, institutional controls and monitoring of soil and groundwater. The site achieved construction completion with signing of the Preliminary Closeout Report in 1997. The Michigan Department of Environmental Quality (MDEQ) conducted a discretionary five-year review in 1998, the trigger for which was the 1993 interim action Record of Decision (ROD). The 1998 five-year review concluded that active treatment conducted at the site had reduced contaminant levels to industrial (Tier 1) goals and that monitoring would continue once active remediation had ceased. The trigger for this second five-year review was the March 1998 Five-Year Review.

This five-year review found that the remedy was constructed in accordance with the requirements of the Remedial Action Plan (RAP). The remedy has functioned as designed and is protective of human health and the environment, as long as exposure pathways that could result in unacceptable risk continue to be controlled. Followup actions include the need to finalize modifications to the Muskegon County Sanitation Ordinance to make it acceptable to the MDEQ, and to consider revisions to the RAP to allow for incorporation of mixing zone based groundwater-surface water interface (GSI) criteria as the remedial action goals (RAGs) for groundwater at the site. It should be noted that, with the exception of one monitoring well located behind the former MCC production facility, groundwater throughout the site complies with the GSI criteria, which were generated in 2002 at the request of Koch Chemical Company (KCC) (see Attachment 5).

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site name *(from WasteLAN)*: **Muskegon Chemical Company Superfund site**		
EPA ID *(from WasteLAN)*: **MID072569510**		
Region: 5	**State: MI**	**City/County: Whitehall/Muskegon**
SITE STATUS		
NPL status: ☒ **Final** ☐ Deleted ☐ Other (specify)		
Remediation status (choose all that apply): ☐ Under Construction ☒ **Operating** ☐ Complete		
Multiple OUs?* ☐ YES ☒ NO	**Construction completion date:** June 26, 1997	
Has site been put into reuse? ☐ YES ☒ **NO**		
REVIEW STATUS		
Lead agency: ☐ EPA ☒ **State** ☐ Tribe ☐ Other Federal Agency _____		
Author name: Robert L. Franks		
Author title: Project Manager	**Author affiliation: MDEQ**	
Review period:** 3/13/1998 to 3/13/2003		
Date(s) of site inspection: 1/31/2003 and 2/18/2003		
Type of review: ☐ Post-SARA ☐ Pre-SARA ☐ NPL-Removal only ☐ Non-NPL Remedial Action Site ☒ NPL State/Tribe-lead ☐ Regional Discretion		
Review number: ☐ 1 (first) ☒ 2 (second) ☐ 3 (third) ☐ Other (specify) _____		
Triggering action: ☐ Actual RA Onsite Construction at OU #____ ☐ Actual RA Start at OU#____ ☐ Construction Completion ☒ Previous Five-Year Review Report ☐ Other (specify)		
Triggering action date *(from WasteLAN)*: 3/30/1998		
Due date *(five years after triggering action date)*: 3/30/2003		

* ["OU" refers to operable unit.]

Five-Year Review Summary Form, cont'd.

Issues:

1. Need to consider KCC's request to amend the RAP to incorporate mixing-zone based GSI criteria as the RAGs for groundwater at the site.
2. Need to work with the City of Whitehall to ensure future protection of the City's municipal drinking water production wells.
3. KCC needs to amend the Muskegon County Sanitation Ordinance if they wish to continue to rely on this ordinance. This must be done before the MDEQ can approve changes to the RAP.
4. MDEQ needs verification from Muskegon County that their Sanitation Ordinance is being effectively implemented and enforced.
5. Deed restriction on MCC plant site on Warner Street needs to be modified to place a prohibition on activities that could result in exposure to the residually contaminated soil under the MCC building.

Recommendations and Follow-up Actions:

1. Continue to work with KCC on proposed changes to the RAP.
2. Continue to have dialogue with the City of Whitehall to ensure protection of the City's drinking water.
3. Ensure that KCC either seeks modifications to the Muskegon County Sanitation Ordinance to comply with MDEQ requirements or implements other appropriate actions.
4. Review the County's processes to ensure that the ordinance is adequately enforced.
5. Ensure that KCC modifies the deed restriction on their Warner Street property to prohibit activities that could result in exposure to the residually contaminated soil under the MCC building.

Protectiveness Statement(s):

The MCC remedy has significantly reduced site-related contaminants. The remedy is considered protective of human health and the environment in the short-term since there is no present exposure pathway to MCC-related contaminants under existing conditions and institutional controls are in place; therefore, there is no current or potential exposure. Follow-up actions are necessary to address long-term protectiveness because remedial action objectives in the 1997 RAP are not expected to be met. The MDEQ is considering reevaluation of the remedial action objectives to incorporate mixing-zone based GSI criteria and that the appropriate updates will be made to the Muskegon County Sanitation Ordinance and the Warner Street plant site deed restriction.

Five-Year Review Report

I. Introduction

The Purpose of the Review

The purpose of five-year reviews is to determine whether the remedy at a site is protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in five-year review reports. In addition, five-year review reports identify issues found during the review, if any, and recommendations to address them.

In March 1993, the MDEQ prepared an Interim Remedial Action (IRA) ROD, addressing a portion of the site's groundwater contamination. After implementing a large part of the remedy, the MDEQ approved a RAP and a preliminary close out, both in June 1997. The first five-year review was conducted by the MDEQ as a discretionary review in 1998, based upon the 1993 IRA ROD. The MDEQ performed the discretionary review because the MDEQ felt that it was necessary since hazardous substances, pollutants, or contaminants remained at the site above levels that allow for unrestricted use and unlimited exposure. This second five-year review is conducted five years from the first five-year review. This five-year review is required by United States Environmental Protection Agency (U.S. EPA) policy. Future five-year reviews will be necessary since hazardous substances, pollutants, or contaminants remain at the site above levels that allow for unrestricted use and unlimited exposure.

Authority for Conducting the Five-Year Review

The Agency is preparing this five-year review pursuant to CERCLA §121 and the National Contingency Plan (NCP). CERCLA §121 states:

> *If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.*

The Agency interpreted this requirement further in the National Contingency Plan (NCP); 40 CFR §300.430(f)(4)(ii) states:

> *If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.*

Who Conducted the Five-Year Review

The MDEQ has conducted a five-year review of the remedial actions (RAs) implemented at the MCC site in Whitehall, Michigan. This review was conducted from January 2003 through March 2003. This report documents the results of the review.

Other Review Characteristics

This is the second five-year review for the MCC site. The triggering action for this review is the date of the previous five-year review, as shown in the U.S. EPA's WasteLAN database: March 13, 1998. The five-year review is required due to the fact that hazardous substances, pollutants, or contaminants remain at the site above levels that allow for unrestricted use and unlimited exposure.

II. Site Chronology

TABLE 1
Site Chronology
Muskegon Chemical Company NPL Site Remedial Action Plan

Date	Activity
1975	MCC begins production at facility.
1977	MCC hires Williams and Works to conduct an investigation at the facility to install an industrial water supply well and observation wells to monitor groundwater quality. The investigation discovered MCC chemicals in the groundwater. The primary contaminants of concern (COCs) are: • 1,2-dichlorethane (1,2-DCA) • bis(2-chloroethyl)ether (Chlorex) • bis(2-chloroethoxy)ethane (TGDC)
1978	Leaking floor drain and collection sump in process building identified as probable release point.
1977-81	Continued study by Williams and Works determines direction of groundwater movement and conducts preliminary assessment of the nature and extent of groundwater contamination downgradient of facility. Williams and Works installs and samples 32 monitoring wells and drills and samples 17 borings.

1981	After environmental sampling is conducted by Williams and Works, surface water contamination is discovered at Mill Pond Creek and is attributed to plume discharge. MCC begins remediating groundwater contamination by pumping contaminated groundwater near facility and discharging it to the Whitehall Area Publicly Owned Treatment Works (POTW).
1983	MCC enters a plea agreement with Muskegon County to implement a plan for groundwater investigation and design of a more comprehensive groundwater extraction system.
1983-84	Groundwater extraction capacity added (extraction wells PW-B, PW-C).
1984-85	PW-D installed. Mill Pond Creek well point interception system installed.
1985	KCC acquires MCC facility and changes name to Koch Chemical Company.
1986	The Michigan Department of Natural Resources (MDNR) and KCC enter into a consent agreement to continue groundwater remediation and investigation activities.
1987-89	KCC expands the extraction system capacity at Mill Pond Creek based upon additional studies performed.
1989	MDNR evaluation concludes that groundwater extraction system next to Mill Pond Creek is not adequately protecting surface water. Recommends site for NPL.
February 21, 1990	U.S. EPA places MCC site on NPL.
1990	KCC develops work plan for remedial investigation/feasibility study (RI/FS). KCC retains CH2M HILL to perform the RI/FS and holds kickoff meeting with MDNR. Revises work plan. KCC performs surface geophysics and well evaluation survey at the site.
March 1991	KCC enters into new consent agreement with the MDNR to perform RI/FS and IRA to prevent further plume discharge to Mill Pond Creek.
Summer 1991	RI and IRA field program.
October 1991	Engineering Evaluation/Cost Analysis report for IRA submitted.
December 1991	Draft RI report submitted.
April 1992	Public comment ROD for IRA. The MDNR selects improved extraction system at Mill Pond Creek.
Fall 1992	IRA construction. Add three new extraction wells (IW-1, IW-2 and IW-3) along north bluff of Mill Pond Creek.
January 1993	Bluff wells activated at average flow rate of 66 gallons per minute (gpm).
March 10, 1993	U.S. EPA issues ROD for IRA (EPA/ROD/R05-93/240), available at http://www.epa.gov/superfund/sites/rodsites/05026031993ROD240rodinfo.

1993-94	Bench-scale soil flushing tests and SVE/air sparging pilot test conducted to address vadose zone soils beneath process building. Extraction well PW-E added to sever source area from remainder of plume.
January 1994	The MDNR releases Public Comment Draft Risk Assessment. Annual sampling of Mill Pond Creek monitoring system and IRA extraction wells demonstrates bluff wells have cut off plume. No MCC COCs detected in Mill Pond Creek.
January 1995	FS report submitted to the MDNR (in September 1995 MDNR became MDEQ).
February 1995	The MDEQ selects expanded groundwater extraction/treatment and in situ technologies as preferred remedies for groundwater and soil.
Spring-Fall 1995	KCC proceeds with remedial design (RD) and begins drafting RAP.
Fall-Winter 1995	RD completed in late summer. Construction of conveyance piping and installation of new extraction wells (EXT1, EXT2 and EXT3) and associated monitor wells.
Spring 1996	Air stripper and new carbon vessels arrive and new system shakedown begins. Expanded extraction and treatment system brought on line in May at flow rate of 410 gpm. Draft RAP submitted to the MDEQ in June. Samples of process building vadose zone soils show that about 95 percent of volatile organic compounds (VOCs) removed by SVE. In situ thermal desorption pilot tests begin in the vicinity of process building sump to address bis (2-chloroethoxy) ether (Chlorex) and bis (2-chloroethyl) ether (TGDC).
Winter 1997	Vadose zone soil sampling results in process bldg. sump area demonstrates effectiveness of in situ thermal desorption in reducing concentrations of Chlorex and TGDC but higher heat needed to further reduce TGDC. Additional heating and blower capacity added to increase effectiveness and expand treatment area.
Spring-Summer 1997	PW-F installed in process building in May to expedite groundwater cleanup in plant area. Tetrachloroethylene (PCE) pocket delineated in shallow groundwater at east end of process building following an extensive groundwater grab sampling investigation. Two additional extraction wells (PW-G and PW-H) and seven additional monitor wells (KCC 30 through KCC36) installed to expedite and monitor progress of PCE cleanup. Additional capacity added to thermal desorption system and treatment area expanded.
November 25, 1997	Effective date of RA consent decree between the MDEQ and KCC filed in U.S. District Court for the Western District of Michigan. Case No. 5:97-CV-211. The 1991 RI/FS and IRA and all previous consent decrees terminated and superceded by this agreement.

1998	Sequential expansion of the in situ thermal desorption system following sampling in February and May to verify achievement of RAGs. Continued operation and adjustments to the groundwater extraction system. First five year review completed (March 13, 1998).
April 1999	Additional groundwater investigative work conducted at the eastern end of the process building to refine location of PCE around PW-H.
Summer 1999	Extensive soil verification sampling in July confirms industrial direct contact and groundwater protection values achieved for vadose zone soils beneath the process building. Active soil remediation terminated in October. Install PW-I & KCC37 east of PW-H and install EXT4 between EXT3 and IW1 in Mill Pond Creek Area to attack selected plume remnants.
December 1999	KCC petitions the MDEQ to terminate active soil and groundwater remediation based on achieving remedial goals in soils and groundwater. The MDEQ generally agrees but administrative issues with RAP format prevent the MDEQ from being able to grant request.
2000	Groundwater extraction continued at selected plume remnants.
December 2000	Amendment to the consent decree, entered between KCC and the MDEQ to incorporate the Muskegon County Ordinance as an accepted institutional control to prohibit water wells, is approved by the U.S. District Court for the Western District of Michigan, Southern Division.
2001	Negotiations on scope of long-term monitoring and revising cleanup criteria consistent with Part 201, Environmental Remediation, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA) criteria. Mixing zone determination request submitted.
Spring/Summer 2002	Mixing Zone GSI criteria provided by the MDEQ. KCC again petitions for and the MDEQ approves request to terminate active groundwater remediation (May 3, 2002). Prepare and submit draft RAP and long-term monitoring plan.

III. Background

Physical Characteristics

The former MCC production facility consists of 19.6 acres located at 1725 Warner Street on the southern outskirts of Whitehall, in Muskegon County, Michigan. The site is located approximately 0.5 mile north of the Mill Pond Creek, and is close to White Lake and Lake Michigan. The area around the former plant is zoned light industrial, and the land to the north and west is occupied by the Whitehall Industrial Park. Howmet Corporation owns and operates production facilities on property west of the site. The land south of the plant is owned by CSX Corporation, south of which are Whitehall Department of Public Works facilities. The surrounding area is largely residential.

Land and Resource Use

The MCC plant began producing specialty chemicals in 1975. Manufacturing was discontinued, and the plant was decommissioned at the end of 1991. Since 1991, no operations have been active at the site, and no process equipment or industrial chemicals remain on site.

The land use of the surrounding area is industrial, commercial, and residential. The area around the plant is zoned light industrial.

The general direction of groundwater flow from the site is southwest toward Mill Pond Creek, located about 0.5 mile south. Groundwater is used as a drinking water source, and private and public wells are located in the vicinity of the site. Surface water within three miles downstream of the site is used for recreational activities.

History of Contamination

In 1977 during investigation for installation of an industrial water supply well, it was discovered that process chemicals had leaked from a floor drain and sump system and contaminated the local water table aquifer near the plant. Contamination was detected in both the soil and groundwater, and the COCs for the site are chlorobenzene, 1,2-DCA, Chlorex, TGDC, toluene, PCE and trichloroethene (TCE).

Initial Response

From 1977-1981, a hydrogeological investigation was conducted which consisted of installing and sampling 32 monitoring wells and 17 soil borings. The investigation determined the direction of groundwater flow toward Mill Pond Creek, provided a preliminary assessment of the groundwater contamination, and determined that surface water contamination was present in Mill Pond Creek. From 1981 to 1989, groundwater remediation was conducted by pumping and discharging to the Whitehall Area POTW. In 1983, MCC entered a plea agreement with Muskegon County to implement a plan for groundwater investigation and design of a more comprehensive extraction system.

In 1986, KCC, who had acquired the property in 1985, entered into a consent agreement with the MDNR to continue groundwater remediation and investigation activities. The system was expanded several times with additional extraction wells, but in 1989 the MDNR concluded that the extraction system was not adequately protecting surface water and recommended the site for the NPL. The site was finalized on the NPL on February 21, 1990.

In March 1991, KCC entered into a new consent agreement with the MDNR to perform RI/FS and IRA to prevent further plume discharge to Mill Pond Creek. The plant ceased operations and was decommissioned in 1991. Throughout 1990 and 1991 the RI and IRA were completed, and April 1992 began the public comment period. IRA construction was performed in 1992, and activated in January 1993. The ROD was issued for the site on March 10, 1993.

Basis for Taking Action

Hazardous substances that have been detected in the site soil and groundwater include:

- Chlorex
- 1,2-DCA
- Chlorobenzene
- TCE
- PCE
- TGDC

Contaminated groundwater has discharged to Mill Pond Creek downgradient from the site, and water supply wells are present in the vicinity of the site.

The risk assessment for the site showed there is no present exposure pathway to MCC-related contaminants under current conditions. However, there are two potential exposure pathways which pose a carcinogenic risk. One potential exposure setting is the future development of the site and occupational or residential exposure to contaminated subsurface soil through direct contact or ingestion. The second potential exposure route is the future use of groundwater as a potable water source at the site.

The risk assessment did not identify unacceptable risk to human health or aquatic life as a result of the discharge of the groundwater plume to Mill Pond Creek.

IV. Remedial Actions

Remedy Selection

Following the listing of the MCC site on the NPL in 1990, a work plan was developed for RI/FS. In March 1991, a new consent agreement was filed to perform RI/FS and IRA to prevent further plume discharge to Mill Pond Creek. Following IRA activities, the ROD was issued on March 10, 1993. Based on the RI/FS, expanded groundwater

extraction/treatment and in situ technologies were selected for site remediation. A RA consent decree was filed November 25, 1997 between KCC and the MDEQ. The consent decree was amended in December 2000 to incorporate the Muskegon County ordinance as an accepted institutional control to prohibit water well installation. The RA continued until the MDEQ provided interim approval of the request to terminate active groundwater remediation on May 3, 2002.

Remedy Implementation

Groundwater

Two RAs were implemented at the site to control the migration of the MCC plume. The first was implemented in 1986 as a result of a consent agreement between the MDNR and KCC. This action included the installation of four groundwater extraction wells along the axis of the plume (purge wells PW-A, PW-B, PW-C, and PW-D) and a well point system along the bank of Mill Pond Creek. The second was an IRA pursuant to the 1990 Consent Order between KCC and the MDNR. Under the IRA, three new interception wells (IW-1, IW-2, and IW-3) replaced the well point system in 1992. An additional well (PW-E) was installed near the plant in 1993 to control migration of contaminated groundwater from this area.

The ROD was issued following IRA activities in March 1993. Prior to the 1996 RA, groundwater was treated via liquid phase carbon and discharged to the sanitary sewer under an existing permit with the Muskegon County Wastewater Treatment System. The maximum allowable discharge was 105 gpm, which had been the limiting factor controlling groundwater withdrawal rates and aquifer restoration.

By 1996, monitoring data showed that previous response actions had successfully cleaned up certain areas of impacted groundwater. However, pockets of elevated COCs remained in four areas: the plant area, Howmet North, Howmet South, and the area south of White Lake Drive termed the Mill Pond Creek area. These areas became the focus of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 1980 PL 96-510, as amended RA for groundwater.

Enhanced groundwater extraction focusing on the four plume remnants was the remedy selected at the conclusion of the FS. The remedy has three basic components: extraction, treatment of extracted groundwater to criteria defined in the RAP, and discharge. The existing system required major upgrades for remedial goals to be achieved in a reasonable amount of time.

Extraction

Modeling conducted during the FS showed that the rate of groundwater extraction needed to be increased by a factor of four, from roughly 105 gpm to more than 400 gpm. The existing extraction wells were not designed to achieve these flow rates, so additional wells were designed and installed. Modeling showed that three

strategically placed high capacity wells (EXT1, EXT2, and EXT3) combined with the three IRA wells would greatly accelerate mass removal and maintain the IRA requirement of preventing plume discharge to Mill Pond Creek. The design flow rate of the system was 420 gpm.

The three new high capacity extraction wells, two reinjection wells (INJ1 and INJ2), and 11 new monitoring wells were installed during the winter of 1995/1996. Step drawdown and pump tests were conducted to determine maximum and optimal pumping rates for each well. It was determined that EXT1 and EXT2 could both be pumped at maximum rates of 300 gpm, and EXT3 could be pumped at 75 gpm. Conveyance lines were also installed at this time. Treatment system upgrades occurred during the late winter and during the spring of 1996. Extraction rates from the wells are shown in Table 2.

TABLE 2
Initial Flow Distribution of 1996 Groundwater Remediation System
Muskegon Chemical Company NPL Site
Remedial Action Completion Report

Well	Flow Rate (gpm)
PWE	31
EXT1	150
EXT2	100
EXT3	70
IW1	23
IW2	23
IW3	23
	420

Discharge

To achieve the four-fold increase in groundwater extraction, it was necessary to identify an alternate discharge point. By 1996, the volume that could be discharged to the POTW had been lowered to 80 gpm, and up to 420 gpm of discharge volume was needed to accelerate plume cleanup. The discharge option selected was injection of treated water back into the aquifer under an MDEQ permit exemption. FS modeling and pre-design aquifer tests indicated that two high capacity injection wells located within the plume footprint, INJ1 and INJ2, could accept all of the projected flow.

Treatment

To achieve the non-detect injection standards specified in the permit exemption, two additional 10,000-lb liquid phase carbon vessels (for a total of four vessels), air stripping, and vapor phase carbon treatment were added to the treatment system. Air stripping was needed to remove 1,2-DCA, as well as other VOCs, because calculations showed that at anticipated influent concentrations, 1,2-DCA breakthrough would occur at a frequency that would make stand-alone granular activated carbon treatment cost prohibitive.

1997 Upgrades

Extraction well PW-F was added inside the process building in May 1997 to accelerate aquifer restoration in the Plant Area. PW-F has a maximum sustainable pumping rate of 60 gpm. In response to an area of elevated PCE concentrations identified beneath and east of the process building, two additional extraction wells (PW-G and PW-H) were added and brought on line during October 1997. These wells were similar in construction to PW-F. At the end of 1997, eight extraction wells were pumping a total rate of 370 gpm, as shown in Table 3.

TABLE 3
MCC Extraction Well Flow Balance c. 1997
Muskegon Chemical Company NPL Site

Well	Flow (gpm)
EXT-1	90
EXT-2	100
EXT-3	50
IW-1	20
IW-2	0
IW-3	0
PW-E	20
PW-F	30
PW-G	30
PW-H	30
Extracted	370
INJ-1	200
INJ-2	160
POTW	10
Discharged	370
Net	0

The success of PW-F in cutting off the process building source area and its contribution to the restoration of groundwater between PW-F and PW-E, (a distance of about 150 ft) was evident from the groundwater quality in KCC 5S and PW-E which by March 1998 had fallen below target detection limits (TDLs). As a result, pumping was discontinued at PW-E and flow allocated to EXT2 to accelerate COC removal in the Howmet North plume remnant. Similarly, pumping was discontinued at PW-G shortly after installation because concentrations of PCE in PW-G and surrounding monitoring wells fell to below Tier 2 RAGs. The short duration of pumping demonstrated that the occurrence of PCE in the PW-G was likely a small isolated spill that probably occurred during the 1992 plant decommissioning.

Final Upgrades – 1999

Two additional wells were added during August 1999:

- EXT4 is located equidistant between EXT3 and IW1 in the Mill Pond Creek area. It is similar in construction to EXT3. The purpose of EXT4 was to accelerate cleanup of the plume remnant south of White Lake Drive. It has a maximum sustainable pumping rate of 60 gpm.

- PW-I was installed in the plant area to expedite removal of the PCE plume remnant in the eastern portion of the plant area. PW-I, located approximately 75 feet east of PW-H, focuses on the plume remnant in the vicinity of monitoring well KCC37. Its construction and pumping rates are similar to PW-F, PW-G, and PW-H.

Soil

The only area of the site where soil impacts were identified was the vadose zone and capillary fringe beneath the process building. These areas were the focus of soil remedial activities which began as voluntary SVE pilot tests in February 1993, and progressed to voluntary air sparge testing during January 1994. These tests occurred in conjunction with preparing the FS. Results of the pilot tests are detailed in the *Feasibility Study Report* (CH2M HILL 1995).

The FS evaluated several remedial technologies and developed six alternatives which included:

- No Action
- Capping
- Excavation and Offsite Disposal
- Soil Vacuum Extraction and Air Sparging
- Soil Vacuum Extraction, Excavation, and Offsite Disposal
- Excavation, Onsite Thermal Desorption, and Onsite Disposal

KCC chose to pursue in situ technologies over excavation, treatment and disposal for safety and cost reasons. Because of the mix of volatile and semivolatile compounds in vadose zone soils, in situ technologies were largely limited to chemical oxidation or in situ thermal desorption combined with SVE. SVE is a proven technology for removing VOCs, but it is only marginally effective in removing SVOCs from the soil matrix because of their low volatility at ambient soil temperatures. Because of the potential drawbacks associated with chemical oxidation, in situ thermal desorption/SVE was the selected remedy.

Results of the early pilot tests showed that both SVE and air sparging were effective in removing VOCs, but they had only negligible effect on the primary SVOCs Chlorex and TGDC. Subsurface soil samples collected in 1995 showed that SVE alone had successfully removed more than 97 percent of the VOCs from beneath the process building, but concentrations of Chlorex and TGDC were essentially the same as before SVE testing began. It was clear that a different technology was needed to remove the SVOC fraction. Chemical oxidation was considered and dropped due to safety and residuals management issues. This left in situ thermal desorption as the only viable candidate.

Pilot testing of in situ thermal desorption as a remedial technology for remediating the SVOCs began in February 1996, and followed the procedures outlined in the *Hot Air Injection & SVE Pilot Study Workplan* (NSI 1996). The basic hot air injection/SVE

operating principal is to heat the soil matrix sufficiently to mobilize the SVOCs by injecting heated air and withdrawing more air than is being injected to maintain a net inward gradient beneath the process building. Extracted air containing volatilized COCs is passed through vapor phase carbon and vented to the atmosphere. Emissions were monitored for breakthrough.

The initial plan of operation specified sequential remediation that injected hot air to raise the temperature of a given block of soil and withdrawal of the vapors from a single direction. Target temperatures were maintained until soil vapor monitoring suggested target analytes were no longer being volatilized, at which point confirmatory soil samples were collected. Once target cleanup levels were achieved, injection and extraction moved to an adjacent location, but the heated soil mass of the previously remediated zone was always taken advantage of to more efficiently and rapidly raise soil temperatures.

The final design involved installing a hot air injection well surrounded by up to three SVE wells spaced 120° apart. The SVE wells were placed within 10 feet of the injector well, which was determined to be the optimal treatment radius from pilot tests. All wells were constructed of fully-penetrating 2-inch diameter stainless steel screens. Air injected into the central well was heated with an electric heater and injected under pressure at a flow rate of 200 scfm. The surrounding SVE wells drew the injected air radially away from the central well at a rate of 300 scfm, facilitating propagation of the heating front and removing volatilized COCs from the soil. Vapors removed from the vadose zone were passed through the twin vapor phase carbon vessels that are part of the air stripper off gas treatment system. Treated vapors were vented to the atmosphere under MDEQ Air Quality permit 112-96. Emissions were monitored using a photo ionization detector.

1996 Pilot Testing

Pilot testing began in the vicinity of the waste water collection trench sump at the northwest corner of the process building during February 1996. This area had the highest concentrations of vadose zone COCs based on RI and subsequent investigations. Initial testing used a single injection and extraction point. A 5 kilowatt (kW) electric heater was used to heat the air to approximately 500° F. The heated air was injected at an average rate of 70 scfm using a 2.5 horsepower (hp) blower and withdrawn from a point 10 feet away at a rate of approximately 100 scfm using a 5 hp blower. Emissions were directed to a 1,000 pound (lb) activated carbon vessel for treatment. Three sets of thermistor nests completed at 10, 20, and 30 feet below ground surface were installed to monitor the propagation of the heating front.

Testing continued through the rest of 1996 using the single injection/extraction configuration. About midway through the year, injection was switched to the extraction well, and vapors were removed from another injection well located 10 ft to the south. At the conclusion of the pilot test, it was determined that the 5 kW heater did not have the capacity to heat the soil matrix to a temperature high enough to drive off TGDC, but it

was effective in removing Chlorex. It was also determined that the optimal spacing between the injection and extraction points was 10 feet.

System Expansion 1997 through 1999

In January 1997, a 9 kW heater and an additional 5 hp blower were added, and remediation progressed sequentially along the north-south leg of the wastewater collection trench. In 1998, the decision was made to double the capacity to accelerate cleanup, and two additional blower/heater assemblies were added. Over this time, it was learned that it took approximately 4 weeks for the soil to reach the temperature needed to mobilize TGDC, and that it took an additional 4 weeks at this temperature, on average, to reach Tier 1 RAGs. By the end of 1998, configuration of the injection/extraction wells changed, with the optimal configuration determined to be injection at a single point and withdrawal from three extraction wells spaced approximately 120° apart.

In the third quarter of 1999, verification sampling showed that all areas of the process building had been successfully remediated to concentrations below Tier 1 RAGs.

Proposed Remedial Actions

Groundwater

The only other RA being contemplated for groundwater at this facility is air sparging to remove the PCE plume remnant at the eastern end of the plant building. While PCE concentrations are below Tier 1 RAGs, and therefore not required to be remediated further through active treatment, KCC and the MDEQ agree that remediation of this area is in the best interest of all parties involved in the MCC site. Air sparging is a proven, effective technology for removing PCE from groundwater. The work is being considered for some time in 2003.

Soil

An impermeable barrier will be constructed over the residual COCs beneath the process building. This will necessitate demolition of the process building and the concrete floor. There are a number of options available for implementing this work and the schedule for implementing the work has not been established.

V. Progress Since the Last Review

The 1998 five-year review supported the shutdown of active remediation at the site. Subsequent monitoring indicated limited exceedances of the Tier 1 RAGs, so active groundwater remediation continued. In the five years since the 1998 review, the additional pumping has had very limited incremental benefit in remediating the remaining plume remnants.

In 2001, KCC requested a mixing zone determination from the MDEQ (see Attachments 4 and 5). The MDEQ's Water Division conducted the mixing zone determination and generated discharge criteria for the MCC COCs. The concentrations allowable in the discharge to Mill Pond Creek are significantly higher than existing concentrations of any MCC COCs, with the one exception of PCE in monitoring well KCC-36, which will be remediated in 2003 by the air sparging system. Therefore, KCC has requested an amendment to the RAP to incorporate the mixing zone based criteria as the groundwater RAGs for the MCC.

The 1997 RAP required the placement of deed restrictions on properties located above the groundwater contaminant plume, which included two properties owned by KCC and property owned by the Howmet Corporation. Deed restrictions were placed on the two KCC owned properties, but KCC was unable to reach agreement with Howmet Corporation on the placement of a deed restriction on their property. Because of this, in 1999 KCC petitioned MDEQ to revise the RAP to allow the use of the Muskegon County Sanitation Ordinance as a groundwater use restriction on the Howmet property. The MDEQ agreed to this RAP modification in 2000. Subsequent to the 2000 RAP modifications, the MDEQ conducted further review of the Muskegon County Sanitation Ordinance and concluded that the ordinance requires certain modifications before any additional sites of environmental contamination may rely upon the ordinance as an effective groundwater use restriction. Therefore, before the MDEQ can formally approve any future modification to the MCC RAP that relies on this ordinance, the Muskegon County ordinance must be modified as well.

VI. Five-Year Review Process

Administrative Components

The potentially responsible party, KCC was notified of the start of the five-year review in late 2002. The MCC five-year review was led by Robert L. Franks, the MDEQ Project Manager for the site, and included the U.S. EPA Remedial Project Manager (RPM) Sheri Bianchin and the U.S. EPA Community Involvement Specialist Don de Blasio.

Discussions between the MDEQ Project Manager and the U.S. EPA RPM resulted in an agreement to target March 31, 2003, as a deadline for submittal of the five-year review report. This date was set based upon the first five-year review as the trigger.

Community Involvement

It was decided by the MDEQ and the U.S. EPA that based upon prior community involvement, a notice would be sent to a local newspaper that the five-year review was being initiated. Then, based upon any responses received from the public, further public information activities would be targeted to address concerns raised, if any. The public notice was published on December 7, 2002, in the Muskegon Chronicle. Neither the MDEQ nor the U.S. EPA received any responses from the public.

The completed five-year review will be placed in the information repository and a notice will be published in the Muskegon Chronicle notifying communities of the completion of the five-year review. It will also be found at the U.S. EPA's website at www.epa.gov/region5/superfund/fiveyear/fyr_index.html. Additionally, interested persons can follow site progress by reading the updated fact sheets found at the U.S. EPA's website www.epa.gov/superfund/sites/npl/mi.htm. Also, updated site information can be obtained through the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) database found at the U.S. EPA's website.

Document Review

This five-year review consisted of a review of relevant documents including the 1997 and 2000 RAPs and consent decrees, quarterly monitoring reports and the mixing zone determination, among others (see Attachment 2).

Data Review

The bulk of the data review consisted of groundwater analytical data from the quarterly monitoring reports. Attempts were made to determine trends, if any, in groundwater contaminant concentrations. It was determined that contaminant concentrations in groundwater have remained relatively steady over the past several quarters. A copy of the most recent quarterly monitoring report is included as Attachment 3.

Site Inspections

Site inspections were conducted on January 31, 2003 and February 18, 2003. The January 31 site inspection began as a meeting at the Whitehall City Library. Attendees of the meeting included Robert L. Franks of the MDEQ, Sheri Bianchin of the U.S. EPA, Frank Van Ryn of Reiss Remediation (a subsidiary of KCC), and Ellen Richard and Brian Sillanpaa both of Barr Engineering. The purpose of the meeting was to discuss the five-year review process, receive a briefing on the history of the site from KCC and Barr Engineering representatives, and provide a forum for discussion/interviews between the MDEQ, KCC and Barr Engineering. Following the meeting at the library, the attendees traveled to the site and toured the former MCC process plant and surrounding areas.

Site Security: The site fencing was in good condition. Security appears adequate for the site.

Main Site Control Building: The main site control building, which is also the former MCC process plant, houses some of the remediation equipment. The remediation equipment (blowers, pumps, carbon vessels, etc.) appear to be in good condition. The building itself is in disrepair. It is understood that KCC has stated that it is their intention to demolish the building, possibly move the remediation equipment to another building and construct a concrete slab over the residual soil contamination beneath the floor of the former process building.

Monitoring Wells: The groundwater monitoring wells inspected on January 31, 2003, appeared to be in good condition and secure. Because of inclement weather on January 31, the parties did not view the portion of the site south of White Lake Drive. This portion of the site inspection was conducted by the MDEQ on February 18, 2003, and included a visual inspection of monitoring wells and extraction wells. It was discovered that several wells were not properly secured. Upon notification of this discovery to Barr Engineering, the wells had locks placed on them within a few days. No other significant findings were made during the February 18 site inspection.

Interviews/Public Meeting

Interviews were conducted with the Site Manager, Frank Van Ryn of Reiss Remediation and Ellen Richard of Barr Engineering, who is in charge of operation and maintenance activities at the site. During these interviews the parties discussed the history of the site, status of remedial activities and work that still needs to be conducted. This work includes working with Muskegon County to modify the county groundwater ordinance, continuing the dialogue with City of Whitehall officials to ensure that the City's drinking water wells remain protected, making appropriate changes to the RAP to incorporate mixing zone based groundwater-surface water interface criteria as the RAGs for the site and continued monitoring.

VII. Technical Assessment

A. Question A: Is the remedy functioning as intended by the decision documents?

The review of documents, applicable or relevant and appropriate requirements, risk assumptions, groundwater monitoring data and the results of the site inspection indicate that the remedy has functioned as intended by the RAP. Tier 1 soil RAGs have been achieved. Tier 1 groundwater RAGs have been achieved throughout the vast majority of the plume. Tier 1 groundwater RAGs are exceeded in only two monitoring wells, with each containing one COC above the Tier 1 RAG.

Access controls, to prevent exposure to site related soil contamination, are intact and functional. At the MCC site, access controls consist of site fencing and the existing floor of the process control building.

Institutional controls, through the use of restrictive covenants and a county groundwater use ordinance, are in place and appear to be functioning as intended. The restrictive covenants on the two KCC properties forbid groundwater wells within 1,000 feet of the plume. The county ordinance forbids water wells in areas defined by the MDEQ as "facilities", unless written permission is obtained from the MDEQ. Further assessment of the county ordinance is needed to ensure the long-term effectiveness of the ordinance. It is currently unclear to the MDEQ exactly how Muskegon County implements the ordinance. The restrictive covenant on KCC's Warner Street property needs to be modified to prevent future development of the residually contaminated soil under the process building.

Monitoring activities, through quarterly groundwater sampling, continue to be conducted. These activities are adequate to determine the protectiveness and effectiveness of the remedy. At this stage of the cleanup, the current monitoring program may be overly aggressive. A request for reduction in the number of monitoring points and/or frequency of sample collection may be approved by the MDEQ as part of the RAP modification in 2003.

B. Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

Human Health Risk Assessment

The exposure assumptions used to develop the Human Health Risk Assessment included both current exposures and potential future exposures. The risk assessment showed there is no present exposure pathway to MCC-related contaminants under existing conditions. Two potential future exposure settings identified in the risk assessment posed an excess lifetime cancer risk greater than 1×10^{-6}. One exposure setting is the potential future development of the site and occupational or residential exposure to contaminated subsurface soil through direct contact or ingestion. The second setting is future residential development on the site and use of contaminated groundwater for potable purposes.

The risk assessment did not identify unacceptable risk to human health or aquatic life as a result of present discharge of the groundwater plume to Mill Pond Creek. However, specific remedial objectives and goals were developed for this exposure route so that future discharge of groundwater to the creek would not pose unacceptable risk. No exposure scenarios resulted in unacceptable noncarginogenic health risks.

Changes in Standards and To Be Considereds (TBCs)

Since RAP approval, there have been no changes in the groundwater or soil criteria that would impact the original Tier 2 RAGs set for the MCC site. There have been no changes that would impact Tier 1 RAGs at the site. However, there may soon be changes that impact the Tier 1 RAGs. These potential changes are discussed in detail in the following section.

Due to extensive changes in the administrative rules for Part 201 of the NREPA it will be necessary for KCC to evaluate any modified RAP they may submit for compliance with the new Part 201 rules.

Changes in Exposure Pathways, Toxicity, and Other Contaminant Characteristics

Tier 1 RAGs

Tier 1 groundwater RAGs were established in the existing RAP by use of a computer model. The model was used to derive what has been termed "attenuated" GSI values. The attenuated GSI value was the concentration of a specific chemical constituent in groundwater such that by the time the groundwater reached Mill Pond Creek, the concentration of the chemical constituent will be equal to or below the published generic GSI value for that compound.

There is now a standardized method in place to evaluate contaminated groundwater discharges to surface water bodies. This evaluation is called a mixing zone determination and is governed by the MDEQ Remediation and Redevelopment Division Operational Memorandum #17 (See Attachment 4).

KCC has requested, and the MDEQ has conducted a mixing zone determination for the MCC site. Site specific discharge criteria have been developed for the COCs at the site (see attachment 5). KCC has requested that MDEQ approve a change in the RAP to replace the Tier 1 RAGs with the mixing zone based discharge criteria. The MDEQ is amenable to this, as long as certain other changes are made, such as modifications to the county ordinance and the restrictive covenant, as well as other requirements relative to the new Part 201 rules. It should be understood however, that at the time of the writing of this five-year review, no changes in the Tier 1 RAGs have been approved by the MDEQ. It should also be understood that any potential changes to the RAP must take into account public comment.

Municipal Drinking Water System

The City of Whitehall uses groundwater as their source of municipal drinking water. The City has commissioned a wellhead protection study in an effort to ensure the long term safety of their source of municipal drinking water. Through this study it was determined that the MCC site is near the ten-year time of travel capture zone for a portion of their municipal wells, although the MCC groundwater contaminant plume migrates away from the direction of the municipal wells. Additionally, the City of Whitehall is in need of locating additional municipal drinking water production wells.

The discovery of the proximity of the MCC site to the ten-year time of travel capture zone for the municipal wells, as well as the future placement of additional municipal drinking water wells represent potential changes in exposure pathways that must be accounted for in the overall evaluation of protectiveness of the MCC remedy.

Discussions and meetings between the MDEQ, City of Whitehall officials, and KCC representatives have taken place. The parties are working in a cooperative fashion to ensure the long term safety of the City of Whitehall's municipal drinking water. KCC and the City are working together to ensure that any potential new municipal production

well is placed in an area and pumped at rates that will not cause changes in groundwater contaminant plume migration. It may be necessary for KCC to incorporate additional monitoring points to act as sentry wells to detect any potential future migration of the plume in directions not previously observed.

No other changes in exposure pathways, chemical toxicity or other contaminant characteristics have been identified that would impact the remedy for the MCC site.

C. Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information, such as additional ecological impacts, unforseen weather events or land use changes have been identified as part of this five-year review that would call into question the protectiveness of the remedy.

D. Technical Assessment Summary

The review of documents and data, along with information gathered during the site inspections indicate that the remedy has performed as anticipated in the RAP. Tier 1 soil RAGs have been achieved. Tier 1 groundwater values have been achieved in all but very limited areas of the plume. Access restrictions and institutional controls are in place and functioning as intended for current needs but need updating to assure future effectiveness. Monitoring is appropriate and ongoing.

No changes in Tier 1 or Tier 2 RAGs were found, although changes to the Tier 1 RAGs may be made in the near future.

The City of Whitehall's wellhead protection study identified the MCC site as being located near the ten-year time of travel capture zone for a portion of their municipal wells. The city also needs to install additional municipal drinking water production wells. Cooperation is needed between the regulatory agency, KCC and the municipality to ensure long term protection of the water supply.

VIII. Issues

Institutional Controls – Changes to the Muskegon County Sanitation Ordinance are necessary if the RAP will continue to rely on this ordinance. Section 20120b (5) of Part 201 of the NREPA requires in part that if a local unit of government adopts a groundwater use ordinance, then the ordinance "...shall include a requirement that the local unit of government notify the department at least 30 days prior to adopting a modification to the ordinance, or to the lapsing or revocation of the ordinance". The current Muskegon County ordinance does not require department notification at least 30 days prior to any modifications to the ordinance. This issue does not affect the current protectiveness of the remedy, but may affect the future protectiveness of the remedy.

There is also uncertainty on the part of the MDEQ regarding how the Muskegon County ordinance is implemented. To improve the MDEQ's understanding of how the ordinance is implemented, information is needed from Muskegon County explaining the day to day operations of their well permitting program and specifics regarding how they take into account the ordinance.

Lastly, the restrictive covenant on KCC's Warner Street property needs to be modified to include a prohibition on activities that could result in exposures to the residually contaminated soil under the former MCC process building.

RAP Modification – KCC is proposing modifications to the RAP that replace the Tier 1 RAGs with discharge criteria developed from the mixing zone determination. This issue does not affect the protectiveness of the remedy.

Long Term Protection Of Municipal Water – Continued efforts need to be made to ensure that the MCC site never impacts the City of Whitehall municipal drinking water wells. The placement of new municipal wells could negatively impact the protectiveness of the remedy, if contaminated groundwater is drawn into the municipal well.

IX. Recommendations and Follow-up Actions

Institutional Controls – KCC needs to work with Muskegon County officials to make necessary modifications to the Sanitation Ordinance if they want to continue to rely on this ordinance.

KCC needs to modify the restrictive covenant on their Warner Street property to include a prohibition on activities that could result in exposures to the residually contaminated soil under the former MCC process building.

An explanation of Muskegon County's well permitting program, with emphasis placed on implementation of the county ordinance, needs to be provided to the MDEQ.

The above modifications to the institutional controls must be in place prior to finalization of modifications to the RAP. Because of a desire on the part of KCC and the MDEQ to finalize modifications to the RAP in June 2003, the timeframe for implementation of the institutional control modifications and any other changes needed to be in compliance with the updated Part 201 rules is also June 2003.

RAP Modification – KCC has proposed modifications to the RAP. In April 2002, the MDEQ approved an interim shutdown of the extraction and treatment system, while the MDEQ and KCC negotiated modifications to the RAP that would incorporate the mixing zone based GSI criteria as a replacement of the Tier 1 RAGs. Progress on this item has stalled until changes to the Muskegon County ordinance are made. If KCC does not submit an approvable RAP, including any necessary modifications to the ordinance by the end of June 2003, the extraction and treatment system will need to be re-started to comply with the existing RAP.

Long Term Protection Of Municipal Water – Continued efforts need to be made to ensure that the MCC site never impacts the City of Whitehall municipal drinking water wells. This includes continuing the dialogue with City officials, sharing information and offering technical expertise as needed to the City of Whitehall. Adding additional monitoring points to the long-term groundwater monitoring program may be necessary as well. This is an ongoing requirement that must be implemented immediately, and continue for the life of the project.

X. Protectiveness Statement(s)

The MCC remedy has significantly reduced site-related contaminants. The remedy is considered protective of human health and the environment in the short-term because there is not current exposure pathway to MCC-related contaminants and institutional controls are in place, and therefore, there is no current or potential short term exposure. Follow-up actions are necessary to address long-term protectiveness because remedial action objectives in the 1997 RAP are not expected to be met. The MDEQ is considering a reevaluation of the remedial action objectives to incorporate mixing-zone based GSI criteria.

XI. Next Review

Because hazardous substances remain at the site above levels that allow for unrestricted use and unlimited exposure, another review will be conducted in five years. The next review will be completed by March 31, 2008.

ATTACHMENT 1
SITE MAPS

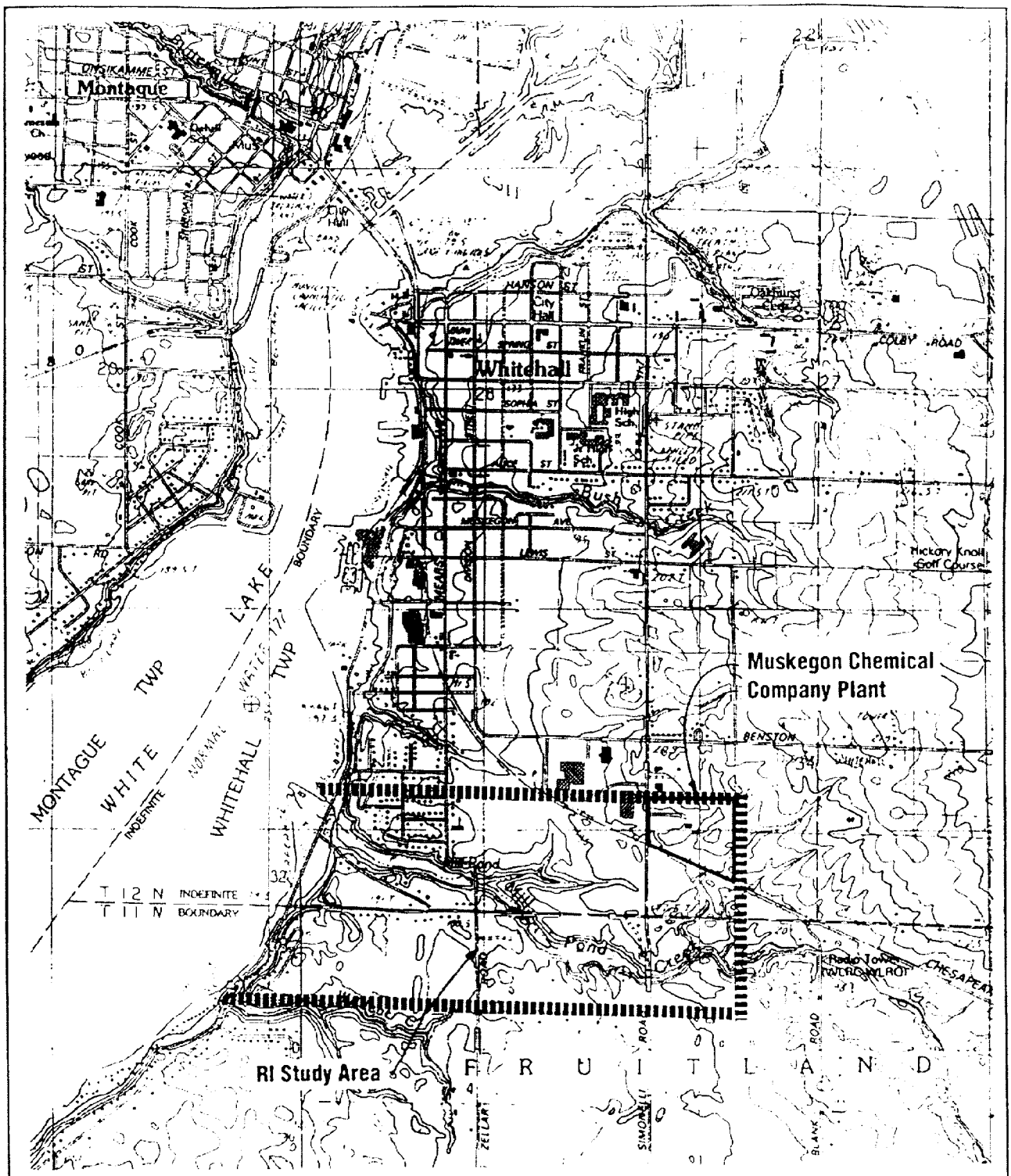


FIGURE 1-1
Site Location Map
Muskegon Chemical Company NPL Site
RI Report

CH2MHILL

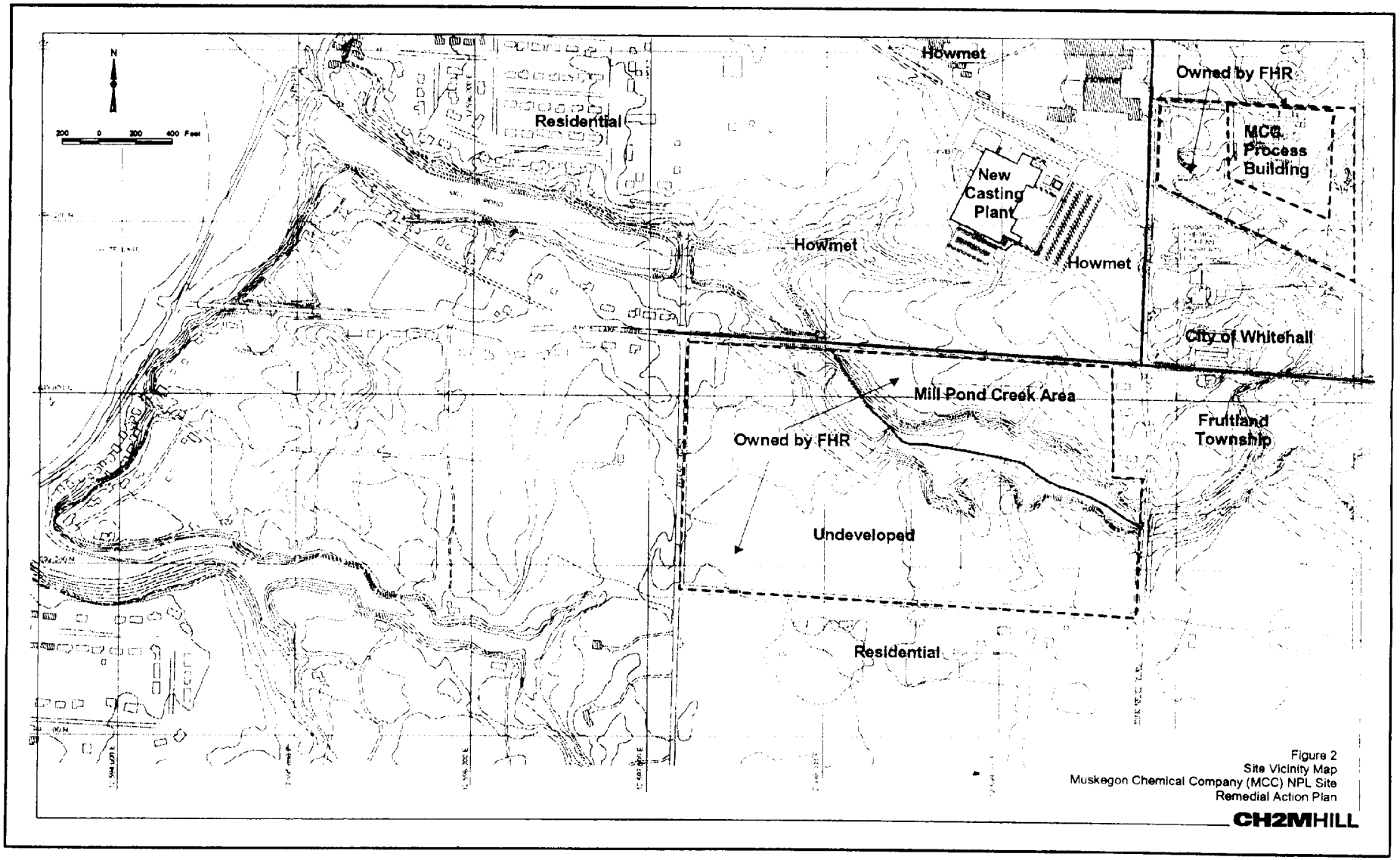


Figure 2
Site Vicinity Map
Muskegon Chemical Company (MCC) NPL Site
Remedial Action Plan

CH2MHILL

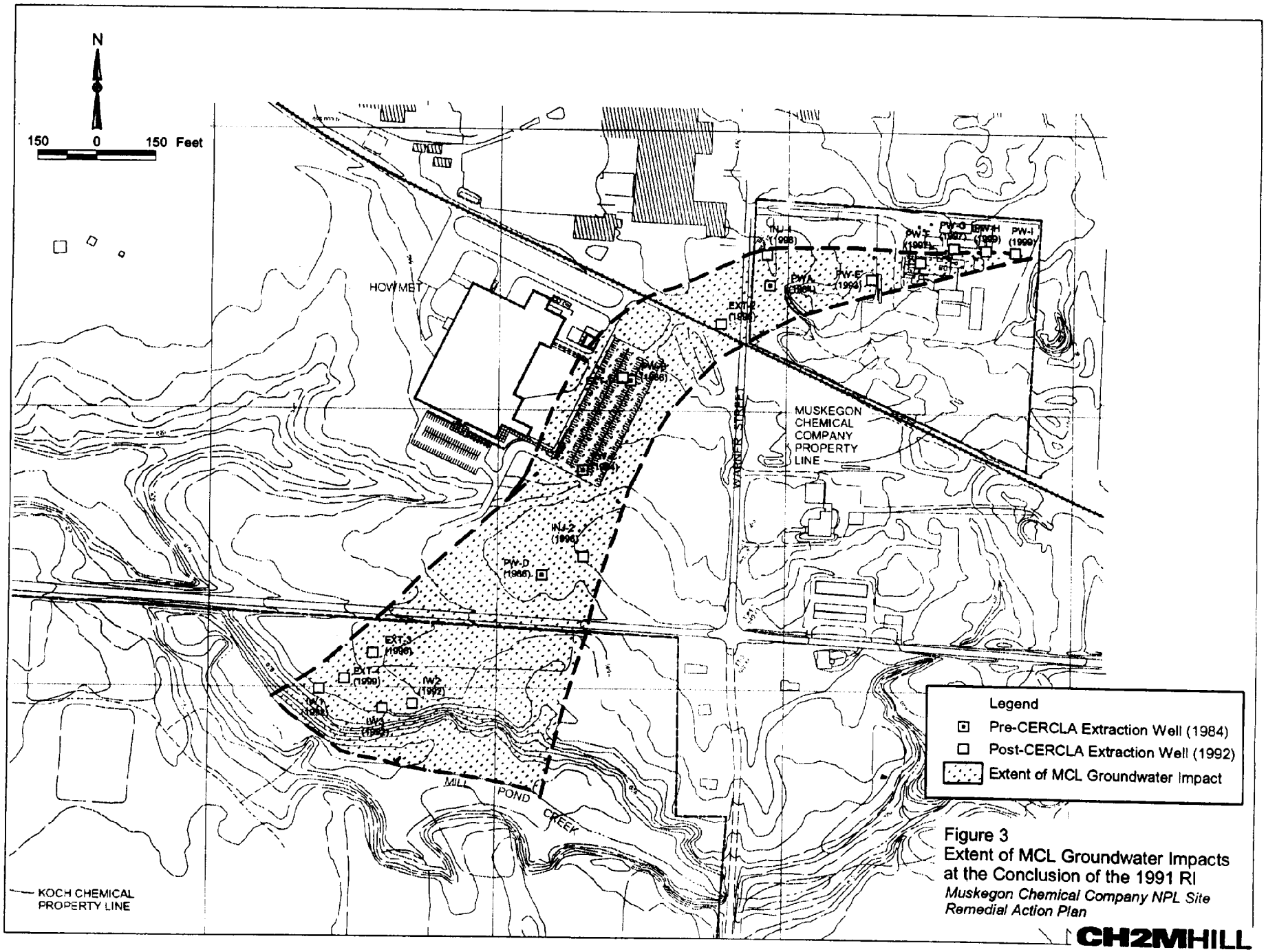


Figure 3
Extent of MCL Groundwater Impacts at the Conclusion of the 1991 RI
Muskegon Chemical Company NPL Site Remedial Action Plan

CH2MHILL

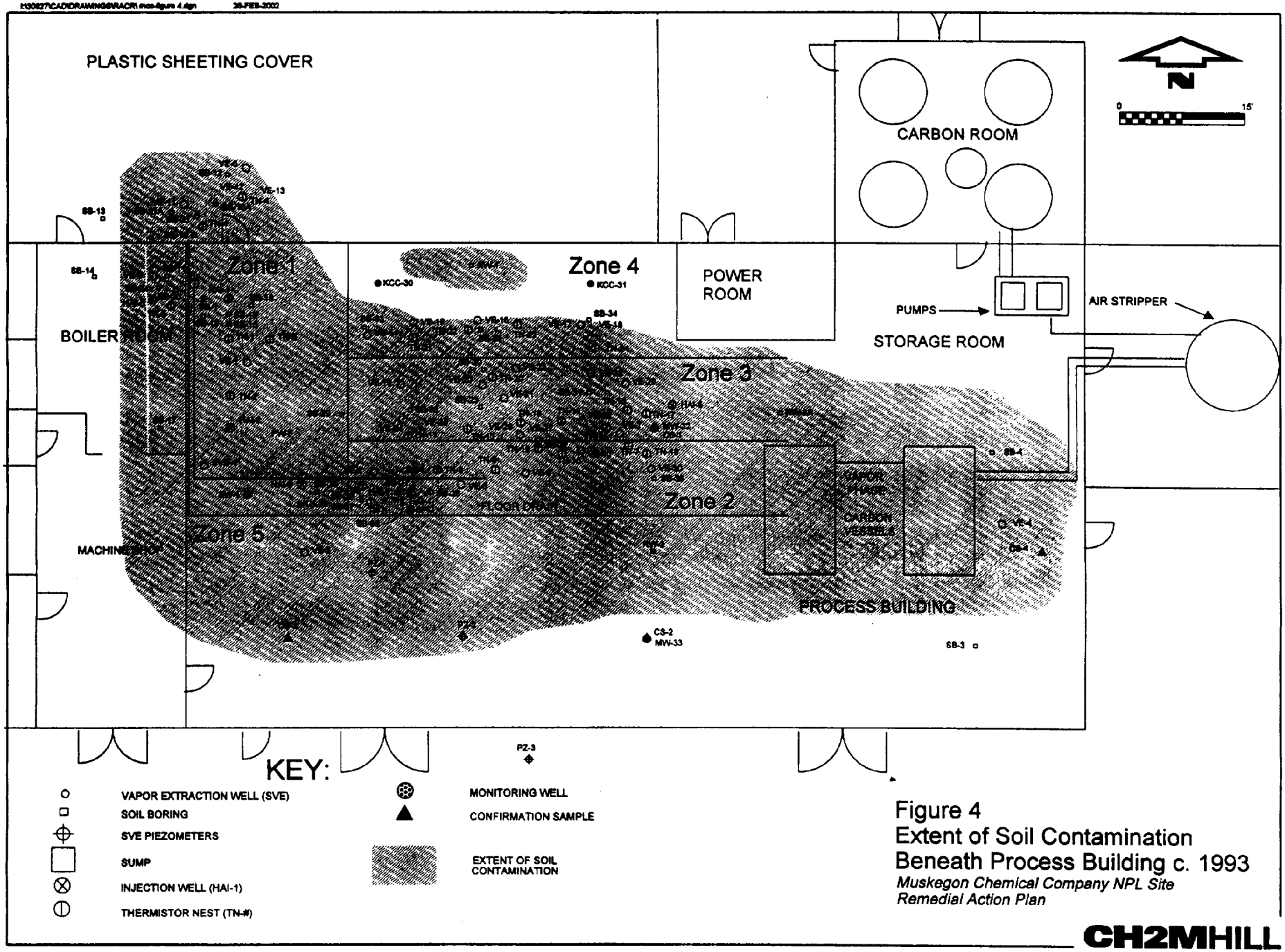


Figure 4
Extent of Soil Contamination Beneath Process Building c. 1993
Muskegon Chemical Company NPL Site
Remedial Action Plan

CH2MHILL

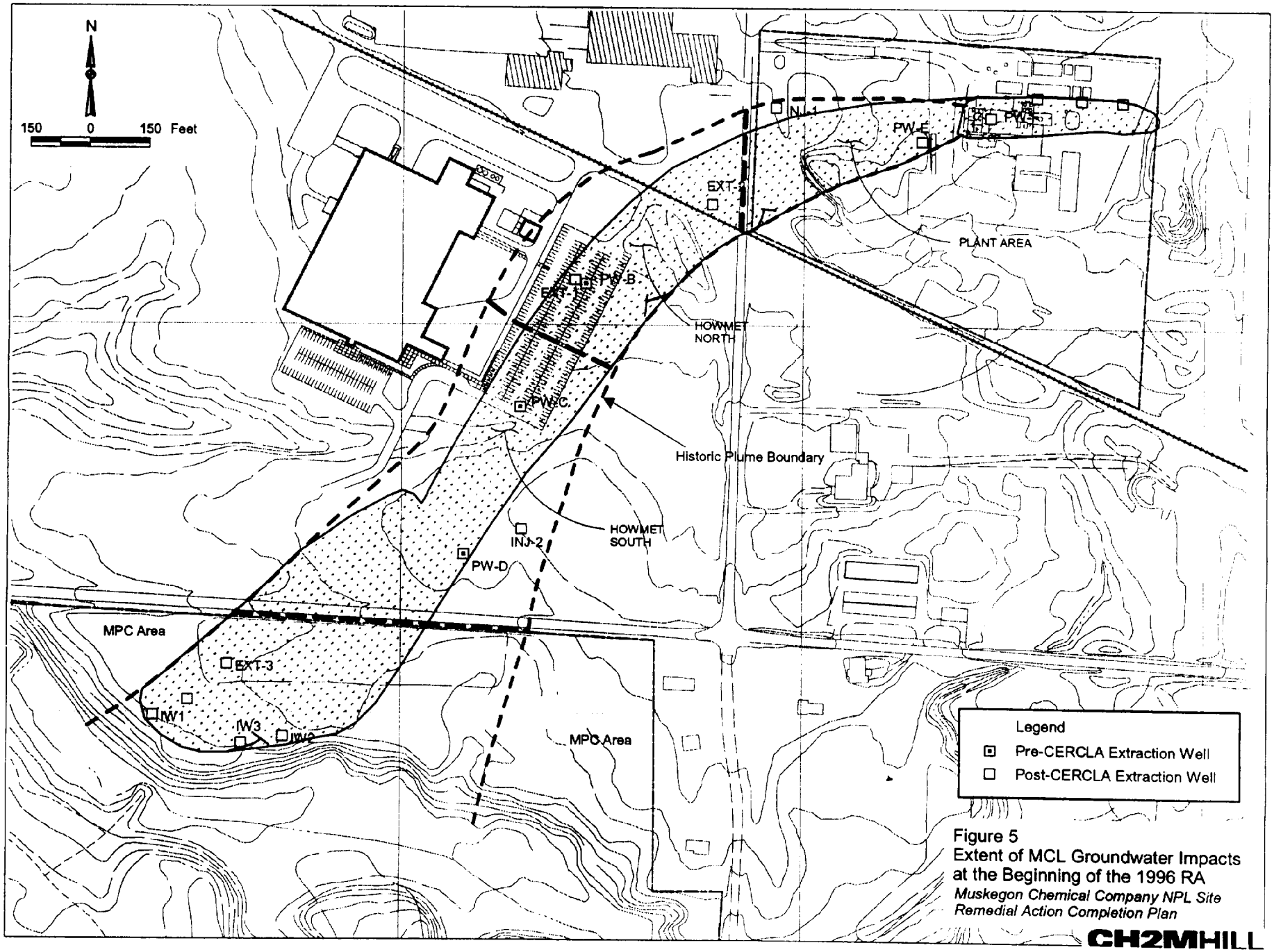


Figure 5
Extent of MCL Groundwater Impacts at the Beginning of the 1996 RA
Muskegon Chemical Company NPL Site
Remedial Action Completion Plan

CH2MHILL

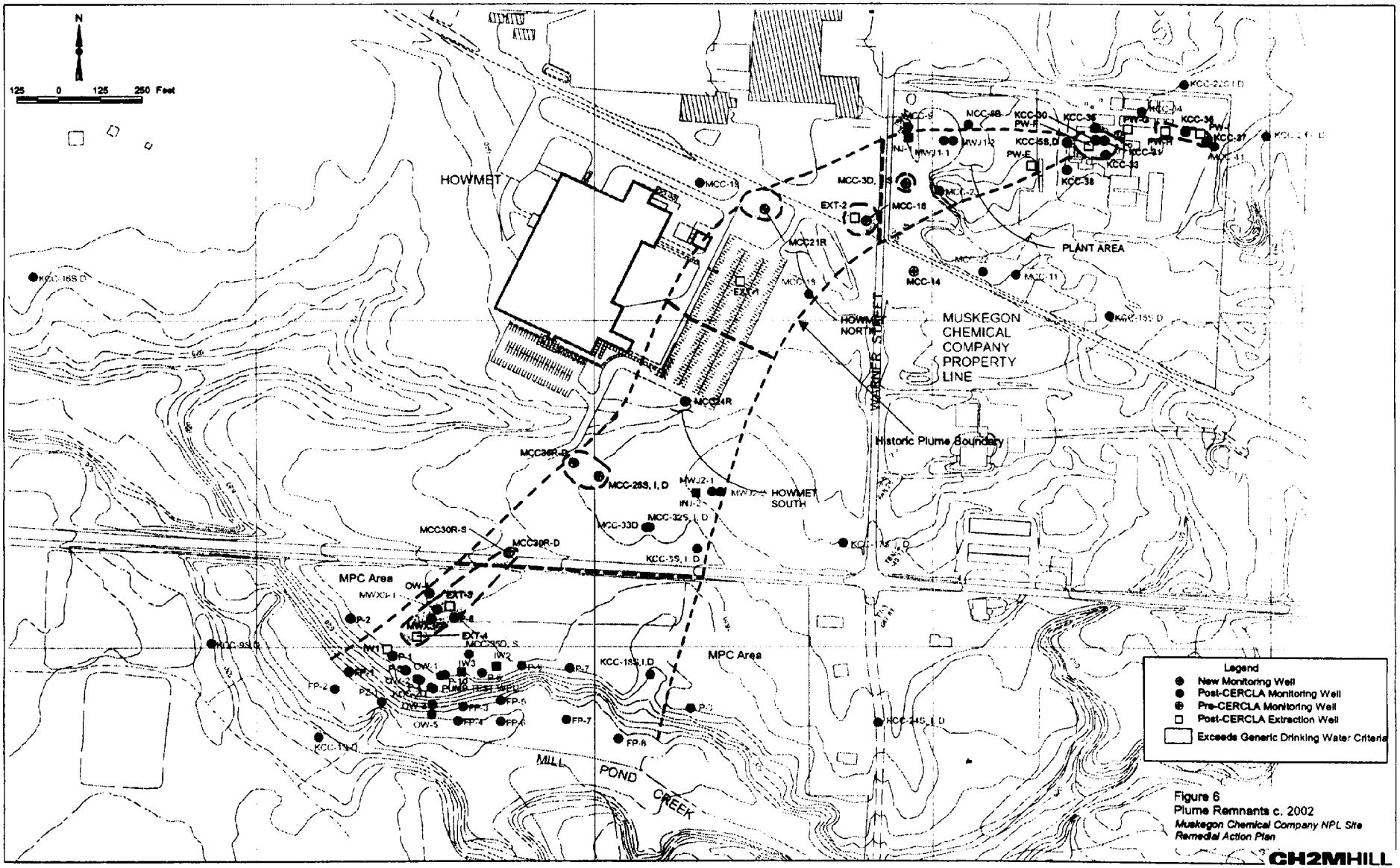


Figure 6
Plume Remnants c. 2002
Muskegon Chemical Company NPL Site
Remedial Action Plan

CH2MHILL

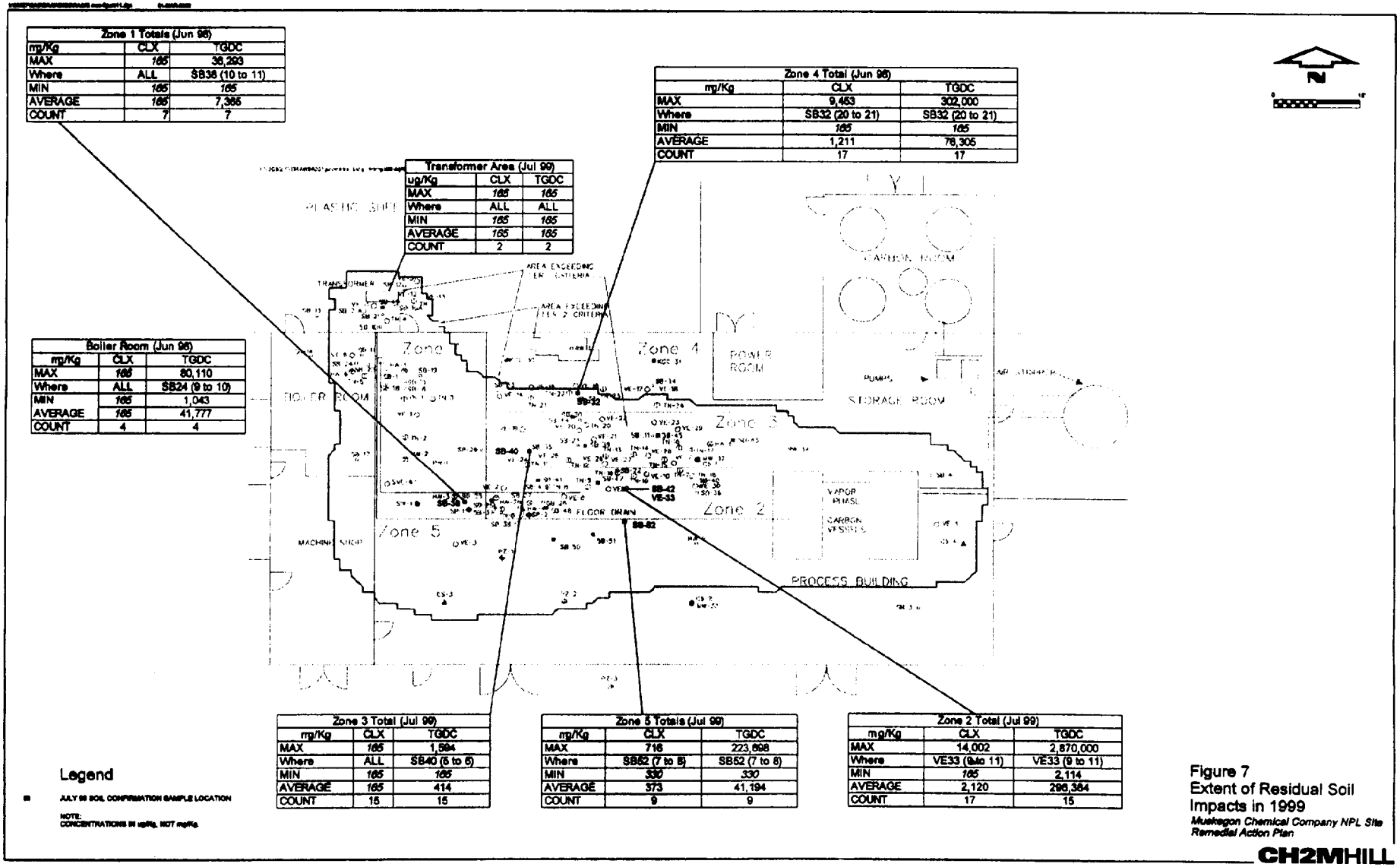


Figure 7
Extent of Residual Soil Impacts in 1999
Muskegon Chemical Company NPL Site Remedial Action Plan

CH2MHILL

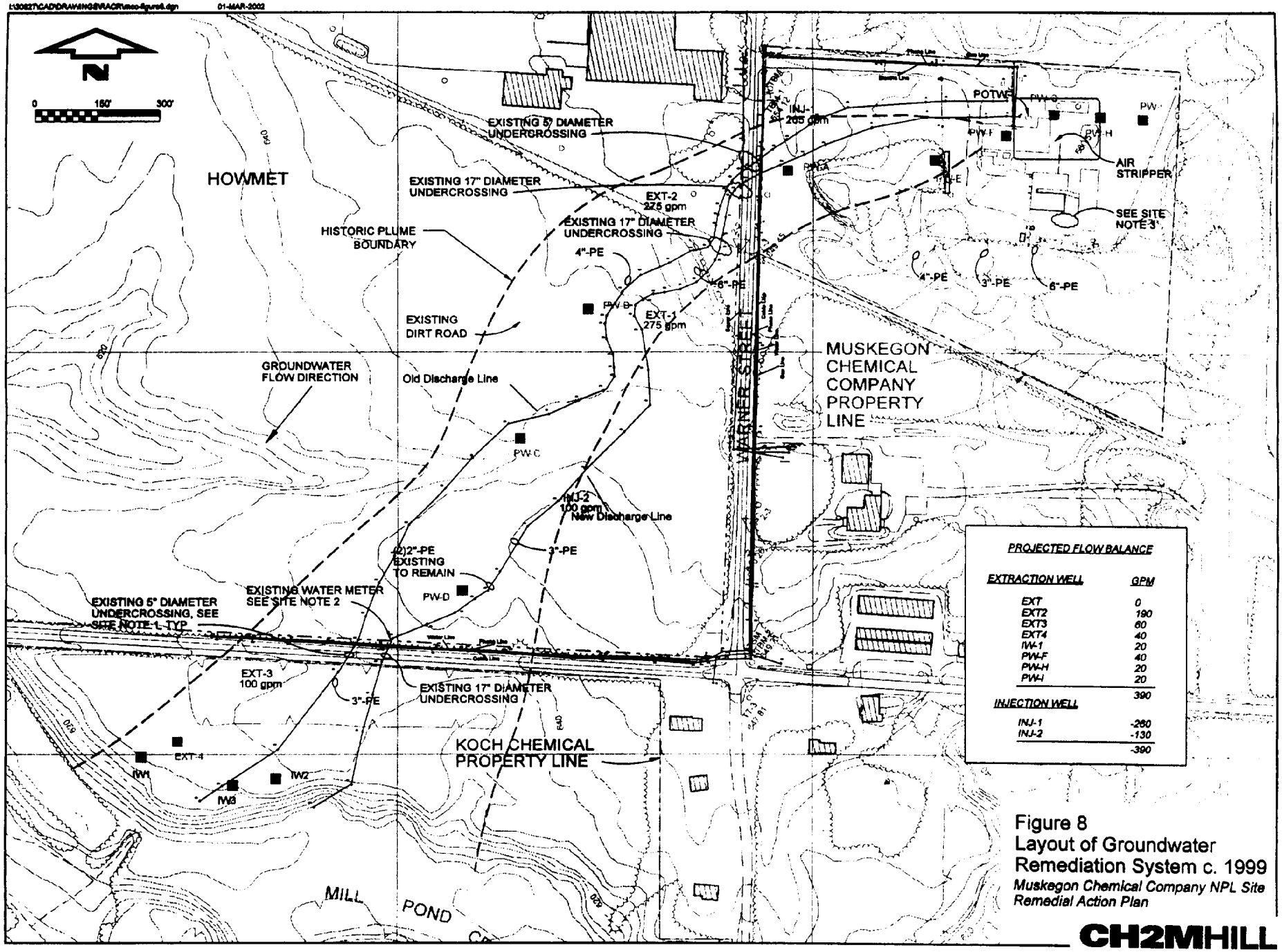
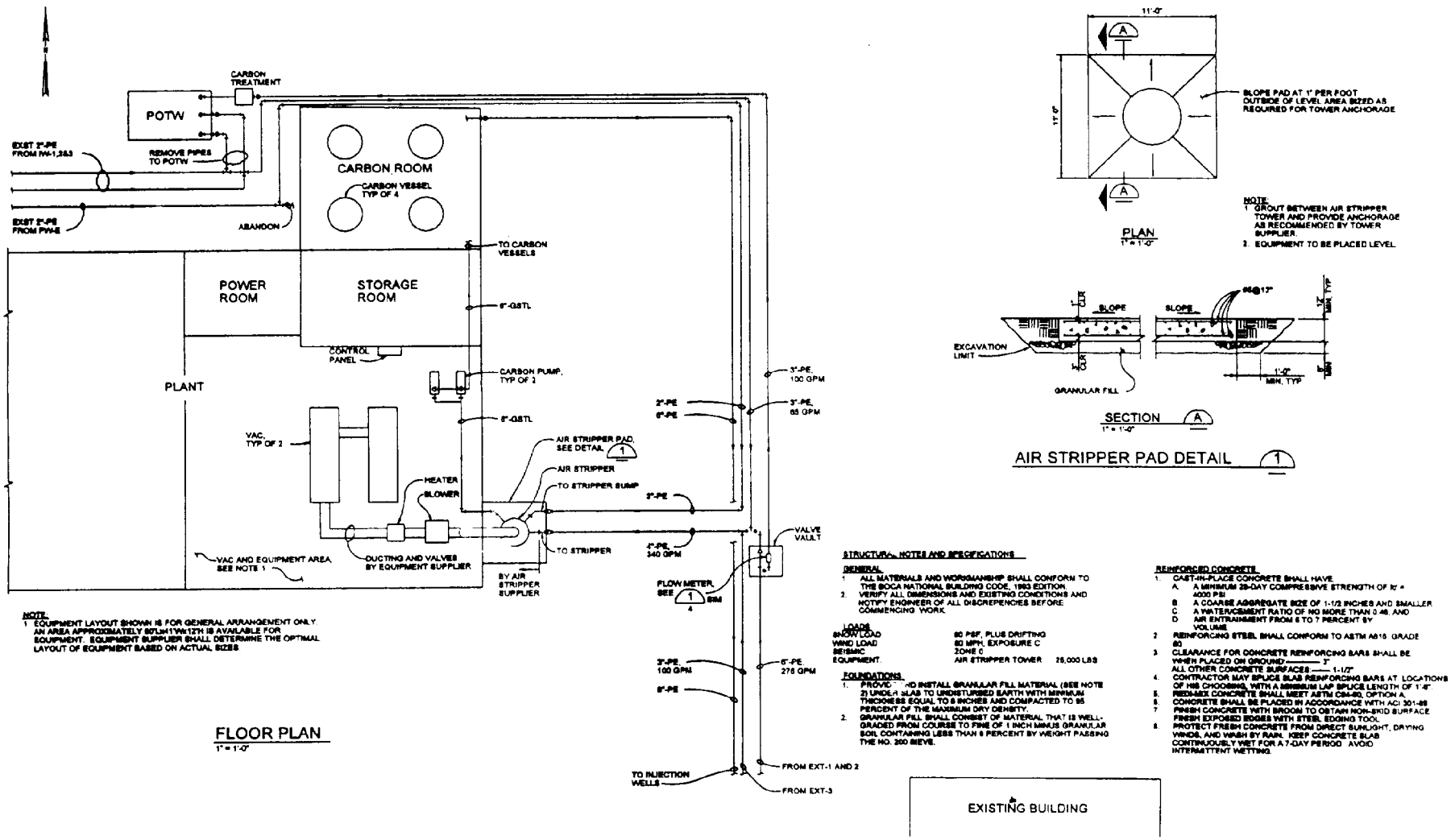


Figure 8
Layout of Groundwater Remediation System c. 1999
Muskegon Chemical Company NPL Site Remedial Action Plan

CH2MHILL



NOTE:
1. EQUIPMENT LAYOUT SHOWN IS FOR GENERAL ARRANGEMENT ONLY. AN AREA APPROXIMATELY 80'Lx41'Wx12'H IS AVAILABLE FOR EQUIPMENT. EQUIPMENT SUPPLIER SHALL DETERMINE THE OPTIMAL LAYOUT OF EQUIPMENT BASED ON ACTUAL SIZES.

FLOOR PLAN
1" = 1'-0"

STRUCTURAL NOTES AND SPECIFICATIONS

GENERAL
1. ALL MATERIALS AND WORKMANSHIP SHALL CONFORM TO THE BOCA NATIONAL BUILDING CODE, 1993 EDITION.
2. VERIFY ALL DIMENSIONS AND EXISTING CONDITIONS AND NOTIFY ENGINEER OF ALL DISCREPENCIES BEFORE COMMENCING WORK.

LOADS

SNOW LOAD	60 PSF, PLUS DRIFTING
WIND LOAD	80 MPH, EXPOSURE C
SEISMIC	ZONE C
EQUIPMENT	AIR STRIPPER TOWER 28,000 LBS

FOUNDATIONS
1. PROVIDE ... TO INSTALL GRANULAR FILL MATERIAL (SEE NOTE 2) UNDER SLAB TO UNDISTURBED EARTH WITH MINIMUM THICKNESS EQUAL TO 6 INCHES AND COMPACTED TO 95 PERCENT OF THE MAXIMUM DRY DENSITY.
2. GRANULAR FILL SHALL CONSIST OF MATERIAL THAT IS WELL-GRADED FROM COURSE TO FINE OF 1 INCH MINUS GRANULAR SOIL CONTAINING LESS THAN 8 PERCENT BY WEIGHT PASSING THE NO. 200 SIEVE.

REINFORCED CONCRETE
1. CAST-IN-PLACE CONCRETE SHALL HAVE
   A. A MINIMUM 28-DAY COMPRESSIVE STRENGTH OF f'c = 4000 PSI
   B. A COARSE AGGREGATE SIZE OF 1-1/2 INCHES AND SMALLER
   C. A WATER/CEMENT RATIO OF NO MORE THAN 0.46, AND
   D. AIR ENTRAINMENT FROM 5 TO 7 PERCENT BY VOLUME.
2. REINFORCING STEEL SHALL CONFORM TO ASTM A615 GRADE 60.
3. CLEARANCE FOR CONCRETE REINFORCING BARS SHALL BE: WHEN PLACED ON GROUND ——— 3"
   ALL OTHER CONCRETE SURFACES ——— 1-1/2"
4. CONTRACTOR MAY SPLICE SLAB REINFORCING BARS AT LOCATIONS OF HIS CHOOSING, WITH A MINIMUM LAP SPLICE LENGTH OF 1'-6".
5. READY-MIX CONCRETE SHALL MEET ASTM C94-90, OPTION A.
6. CONCRETE SHALL BE PLACED IN ACCORDANCE WITH ACI 301-89.
7. FINISH CONCRETE WITH BROOM TO OBTAIN NON-SKID SURFACE. FINISH EXPOSED EDGES WITH STEEL EDGING TOOL.
8. PROTECT FRESH CONCRETE FROM DIRECT SUNLIGHT, DRYING WINDS, AND WASH BY RAIN. KEEP CONCRETE SLAB CONTINUOUSLY WET FOR A 7-DAY PERIOD. AVOID INTERMITTENT WETTING.

Figure 9
System Schematic
Groundwater Treatment
Muskegon Chemical Company NPL Site
Remedial Action Plan

CH2MHILL

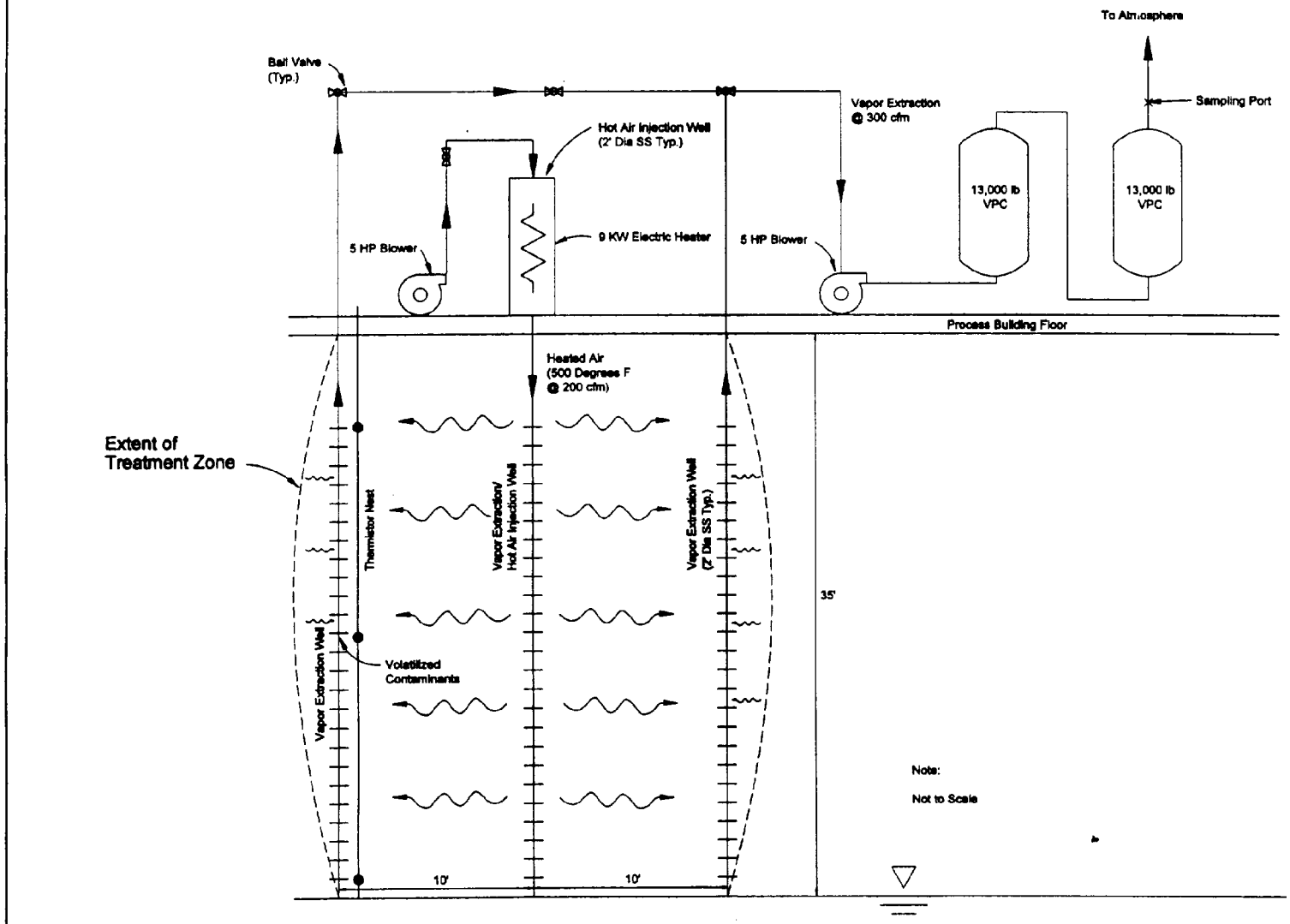


Figure 10
In Situ Thermal Desorption System, Typical
Muskegon Chemical Company NPL Site Remedial Action Plan

CH2MHILL

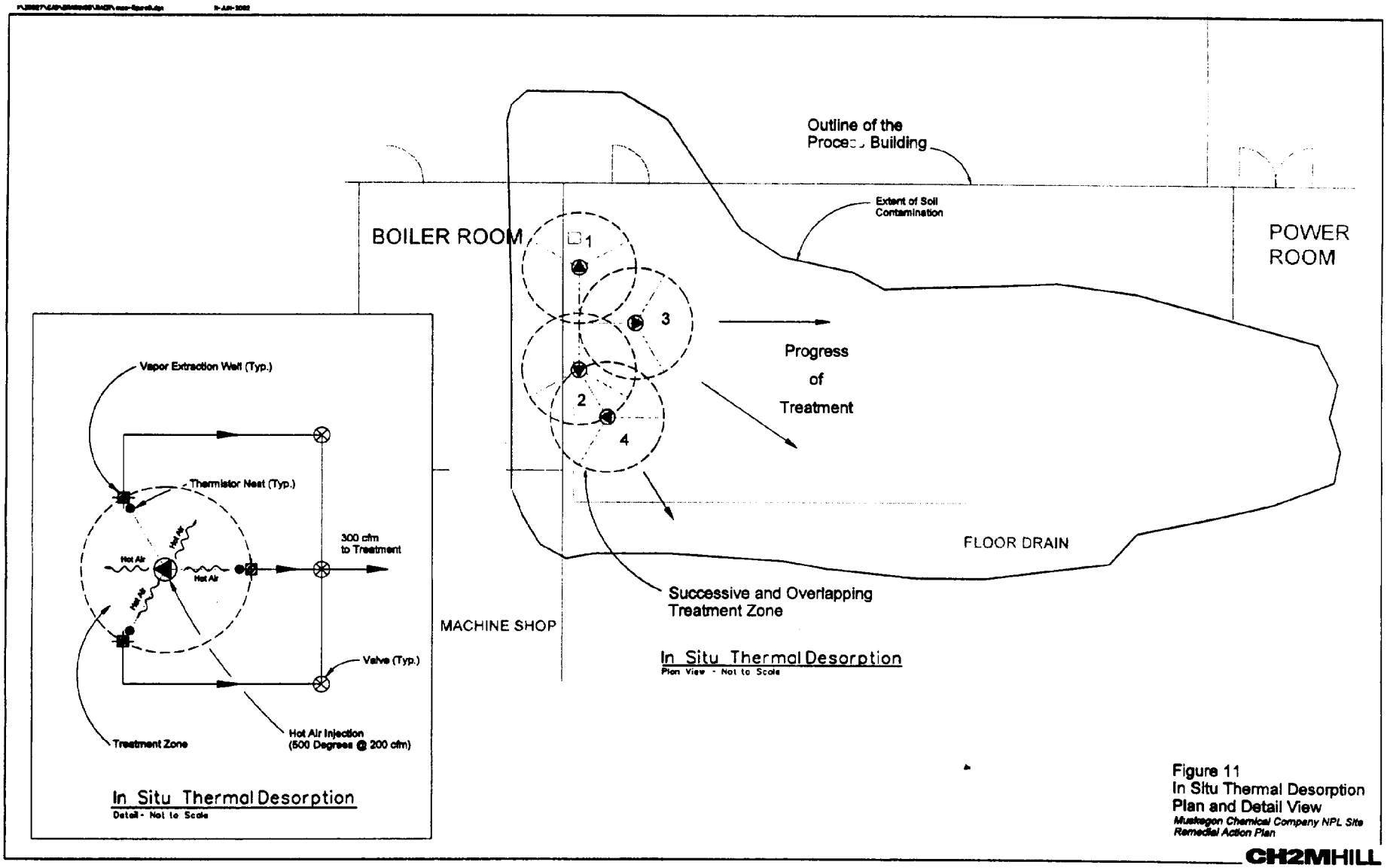


Figure 11
In Situ Thermal Desorption
Plan and Detail View
Muskegon Chemical Company NPL Site
Remedial Action Plan

CH2MHILL

ATTACHMENT 2
LIST OF DOCUMENTS REVIEWED

ATTACHMENT 2

List of Documents Reviewed

- *Remedial Investigation Report,* January 1995.
- *Feasibility Study,* January 1995.
- *Baseline Human Health Risk Assessment,* April 1996.
- *Remedial Action Consent Decree, Case # 5:97-CV-211,* November 25, 1997.
- *Environmental Response Division Operational Memorandum #17,* September 8, 1998.
- *Wellhead Protection Plan,* July 2002.
- *Forty-eighth Quarterly Progress Report,* January 14, 2003.

ATTACHMENT3
FORTY-EIGHT QUARTERLY MONITORING REPORT

BARR

Barr Engineering Company
4700 West 77th Street • Minneapolis, MN 55435-4803
Phone: 952-832-2600 • Fax: 952-832-2601 • www.barr.com

Minneapolis, MN • Hibbing, MN • Duluth, MN • Ann Arbor, MI • Jefferson City, MO

January 14, 2003

Mr. Robert Franks
Michigan Department of Environmental Quality
Environmental Response Division—Superfund Section
301 South Capitol Drive
Lansing, MI 48933

Subject: Forty-eighth Quarterly Progress Report: Period Covered: 01 October–31 December 2002
Muskegon Chemical Company NPL Site
Docket No. DPO-MCC-91-002

Dear Mr. Franks:

As requested by Reiss Remediation, Inc. (RRI) Barr Engineering, has prepared this quarterly report in accordance with the Consent Agreement between Koch Chemical Company and the Michigan Department of Environmental Quality (MDEQ). This letter is submitted as the Forty-eighth Quarterly Progress Report for the Muskegon Chemical NPL site. Analytical Data included in this report was collected by Severn Trent Services. A copy of the field notes for the fourth quarter sampling event is included as Attachment A.

1. Progress Made This Reporting Period

Groundwater Remediation System Operation and Maintenance

The groundwater remediation system was shut down on May 06, 2002 following conditional approval from MDEQ. The system was inspected on December 9, 2002 by RRI and Barr Engineering.

COC Distribution

Well sampling for the fourth quarter of 2002 occurred during the third week of December. The wells listed in Table 1 are part of the bridge sampling program agreed to by RRI and MDEQ. The bridge sampling program is the interim groundwater sampling program that will be in place until the long-term, post-shutdown groundwater monitoring program appended to the Remedial Action Plan (RAP) is agreed to by both parties.

TABLE 1
Fourth Quarter 2002 Groundwater Sampling Locations—Bridge Program[1]
Muskegon Chemical Company NPL Site

Plant Area (11)		Howmet North (4)	Howmet South(4)	Mill Pond Creek Area (7)	
KCC5S	KCC36	MCC16	MCC24R	OW4	P2
KCC30	KCC37	MCC14	MCC25D	P8	P5
KCC31	KCC38	MCC21R	MCC36R	MWX3-2	FP1
SW-1	MCC3I	EXT1	MCC30R-S	P1	
KCC33	MCC3D				
KCC35				Total	26

[1] Extraction wells PWE, PWF, PWH, PWI, EXT3, EXT4 and IW1sampled in the second quarter were not sampled in the fourth quarter since the extraction system was no longer in operation.

As was also reported for the third quarter of 2002, the fourth-quarter sampling effort deviated from the original program in that none of the bridge program extraction wells (PWE, PWF, PWH, PWI, EXT3, EXT4 and IW1) could be sampled without reactivating the system. RRI does not see this as a serious data gap since each of these wells is associated with a nearby monitor well. Within the Plant, RRI sampled inactive sparge well SW-1 in place of PWF. No other substitutions were made. As a result, samples were collected from 26 wells instead of the 32 wells sampled in the second quarter of 2002.

Table 2 (attached) lists the fourth-quarter 2002 analytical results. Figure 1 shows the distribution of contaminants of concern (COCs) in the Mill Pond Creek (MPC) Area over the same period. Concentrations of site COCs increased slightly in a subset of the Plant Area and Howmet North wells relative to the reported concentrations for the third quarter of 2002. Table 3 lists the maximum COC concentrations observed in the MPC area wells over the last two years. As can be seen, concentrations in the MPC area wells are well below the MZGSI criteria.

TABLE 3
Maximum COC Concentration in MPC Area Wells in Last Eight Quarters. Compared to MZ GSI Criteria
Muskegon Chemical Company Site Remedial Action Plan

COC	Maximum Concentration in MPC Area Wells Last Eight Quarters			Remedial Action Goal (Mixing Zone GSI (µg/L)
	Concentration (µg/L)	Well	When	
1,2-DCA	149	P-8	Jun-01	15,000
PCE	3.3	FP-1	Jun-02	710
TCE	2	FP-1	Mar-01	3,200
CBZ	7	P-8	Jun-01	750
CLX	8.2 J	MWX-3-2	Dec-02	770
TGDC	617	MWX3-2	Jun-01	23,000

Table 4 (attached) summarizes hydraulic head elevations (static groundwater levels) measured for the fourth quarter groundwater sampling event. These elevations are contoured on the attached Figure 2.

Administrative

RRI (Frank Van Ryn and Mike Brom) and their consultants met with Rob Franks and City of Whitehall staff on December 10, 2002 to discuss progress made at the site and future plans. MDEQ noted that the Muskegon County Sanitation Ordinance modifications needed to be in place before MDEQ would approve the RAP. The City of Whitehall Wellhead Protection Plan (Prein & Newhof, July 2002) and city plans to site new production wells(s) were also discussed as they related to the site.

2. Problems Resolved

The reported concentrations of site COCs for monitoring well MCC-16 are inconsistent with historical concentrations. This well was re-sampled on January 13, 2003 and "split" samples were sent to Severn Treat Services laboratory in North Canton, Ohio and to Trimatrix Laboratory in Grand Rapids, Michigan. Data from the monitoring well MCC-16 re-sample were not available at the time this progress report was published.

3. Problem Areas and Recommended Solutions

None.

4. Deliverables Submitted

The following deliverables were submitted during the fourth quarter of 2002:

- The 47th Quarterly Progress Report was submitted to the MDEQ on October 15, 2002.

5. Activities Planned During the First Quarter of 2003 (January 1, 2003 to March 31, 2003)

The following activities are anticipated:

- Secure amendment to the Muskegon County Sanitation Ordinance.
- Perform quarterly monitoring of the groundwater performance and compliance monitoring system in March 2002.
- Re-sample MCC-16 on January 13, 2003.
- Conduct Five-Year Review site visit and meeting on January 31, 2003.
- Evaluate PCE area treatment options and begin treatment system design.

RRI remains committed to moving towards site closure, consistent with the MDEQ approved RAP and redeveloping the affected properties controlled by RRI. If you have any questions or comments on this report, please call Frank Van Ryn at 316-828-2146.

Sincerely,

For

Ellen Richard
Project Manager

Enclosures

c: Frank Van Ryn/Reiss Remediation, Inc.
M.L. Hinchey
Keith Shell/Howmet
Susan Franzetti/Sonnenschein Nath & Rosenthal
Scott Huebler/City of Whitehall


Tables

Table 2
Groundwater Analytical Results for December 2002
Muskegon Chemical Company NPL Site

(concentrations in ug/L)

	Plant Area										
Location	KCC-5S	SW-1	KCC-30	KCC-31	KCC-33	KCC-35	KCC-36	KCC-37	KCC-38	MCC-3D	MCC-3I
Date	12/16/2002	12/18/2002	12/18/2002	12/18/2002	12/18/2002	12/16/2002	12/18/2002	12/18/2002	12/16/2002	12/16/2002	12/16/2002
1,2-Dichloroethane	<6.7	<1.0	0.41 j	<1.0	<25	<6.7	<100	<33	<2.5	1.8	0.41 j
1,2-Dichloroethylene	6.2 j	<1.0	<1.0	<1.0	<25	<6.7	<100	<33	55	<1.0	<1.0
Chlorobenzene	16	<1.0	<1.0	<1.0	<25	<6.7	<100	<33	<2.5	<1.0	<1.0
Tetrachloroethylene	140	<1.0	5.0	18	400	120	1700	590	19	<1.0	<1.0
Trichloroethylene	8.3	<1.0	10	<1.0	<25	<6.7	<100	<33	5.4	<1.0	<1.0
Vinyl chloride	<6.7	<1.0	<1.0	<1.0	<25	<6.7	<100	<33	<2.5	<1.0	<1.0
bis(2-Chloroethoxy)ethane	<10	5.3 j	<10	<10	<10	<10	<10	<10	<10	15	18
Bis(2-chloroethyl)ether	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10

	Howmet North				
Location	EXT-1	EXT-1	MCC-14	MCC-16	MCC-21R
Date	12/16/2002	12/16/2002	12/16/2002	12/18/2002	12/17/2002
Dup		DUP			
1,2-Dichloroethane	<1.0	<1.0	<1.0	<6.7	3.9
1,2-Dichloroethylene	<1.0	<1.0	<1.0	<6.7	<1.0
Chlorobenzene	<1.0	<1.0	<1.0	110	<1.0
Tetrachloroethylene	<1.0	<1.0	<1.0	<6.7	<1.0
Trichloroethylene	<1.0	<1.0	<1.0	<6.7	<1.0
Vinyl chloride	<1.0	<1.0	<1.0	<6.7	<1.0
bis(2-Chloroethoxy)ethane	<10	<10	<10	3600	140
Bis(2-chloroethyl)ether	<10	<10	<10	370 j	5.8 j

Table 2
Groundwater Analytical Results for December 2002
Muskegon Chemical Company NPL Site

(concentrations in ug/L)

	Howmet South			
Location	MCC-30RS	MCC-36R	MCC-24R	MCC-25D
Date	12/17/2002	12/17/2002	12/16/2002	12/17/2002
1,2-Dichloroethane	99	53	0.33 j	0.43 j
1,2-Dichloroethylene	<6.7	<2.0	<1.0	<1.0
Chlorobenzene	<6.7	<2.0	<1.0	<1.0
Tetrachloroethylene	<6.7	<2.0	<1.0	<1.0
Trichloroethylene	<6.7	<2.0	<1.0	<1.0
Vinyl chloride	<6.7	<2.0	<1.0	<1.0
bis(2-Chloroethoxy)ethane	69	110	<10	<10
Bis(2-chloroethyl)ether	6.2 j	4.7 j	<10	<10

	Mill Pond Creek Area						
Location	FP-1	MWX-3-2	OW-4	P-1	P-2	P-5	P-8
Date	12/17/2002	12/17/2002	12/17/2002	12/17/2002	12/17/2002	12/17/2002	12/17/2002
1,2-Dichloroethane	17	130	24	24	9.8	19	52
1,2-Dichloroethylene	1.7	<6.7	<1.0	<1.0	<1.0	<1.0	<2.5
Chlorobenzene	0.99 j	2.9 j	<1.0	1.7	<1.0	2.1	1.2 j
Tetrachloroethylene	1.1	<6.7	<1.0	<1.0	0.44 j	0.68 j	<2.5
Trichloroethylene	0.49 j	<6.7	<1.0	0.53 j	0.47 j	0.42 j	<2.5
Vinyl chloride	<1.0	<6.7	<1.0	<1.0	<1.0	<1.0	<2.5
bis(2-Chloroethoxy)ethane	1.6 j	86	150	1.9 j	<10	77	47
Bis(2-chloroethyl)ether	<10	8.2 j	<50	<10	<10	<20	3.7 j

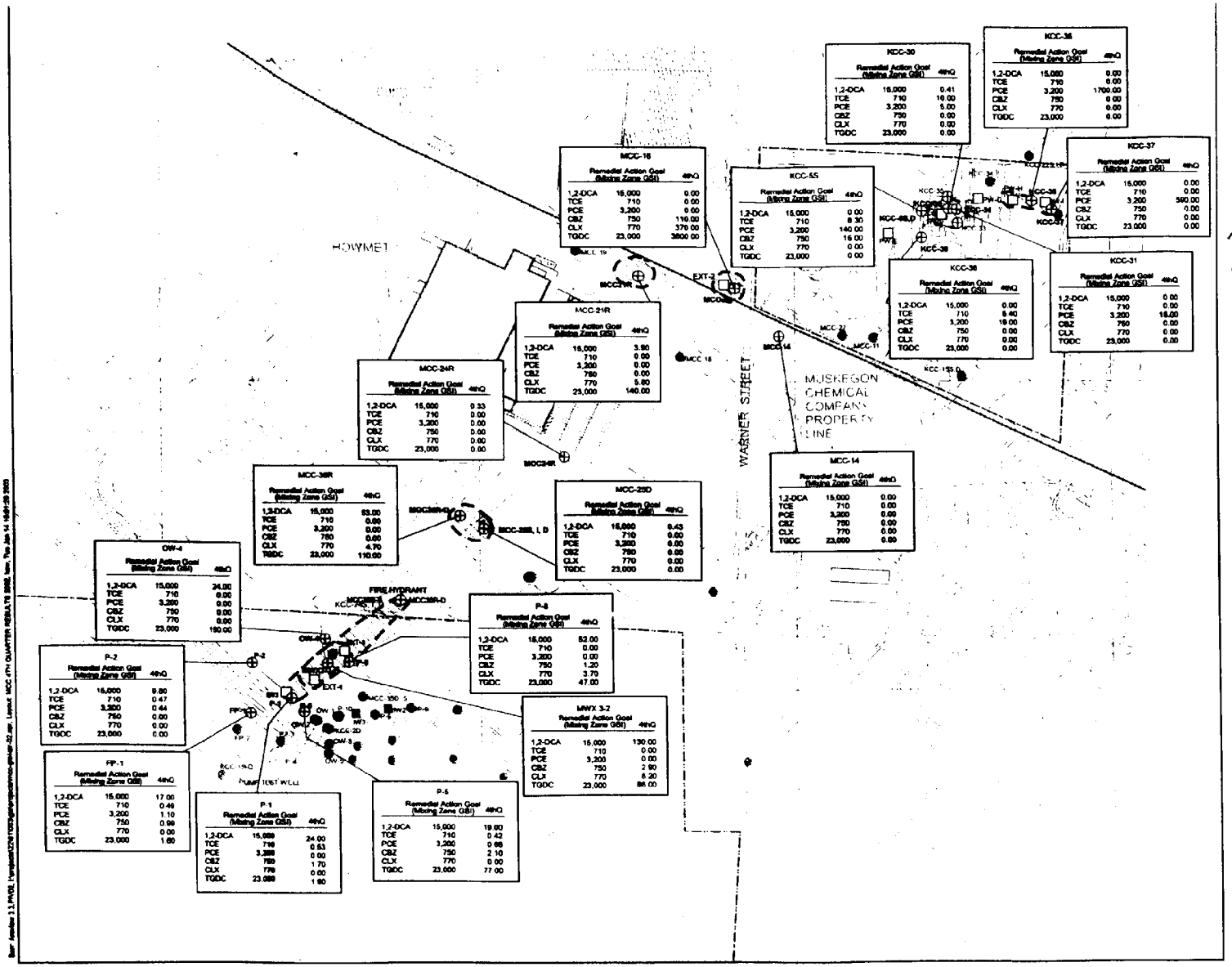
j Reported value is less than the stated laboratory quantitation limit and is considered an estimated value.

Table 4
Hydraulic Head (Static Water Level) Elevations
Muskegon Chemical Company NPL Site
December 16-18, 2002

Well Identification	TOC Elevation (ft. amsl)	Depth to Water (ft)	Hydraulic Head (Static Water) Elevation (ft.)
MCC-3D	650.87	27.67	623.20
MCC-3I	651.49	28.20	623.29
KCC-5S	660.92	36.05	624.87
KCC-30	663.20	37.86	625.34
KCC-31	663.35	37.97	625.38
KCC-33	661.62	36.28	625.34
KCC-35	665.41	38.55	626.86
KCC-36	664.72	38.53	626.19
KCC-37	664.76	38.35	626.41
KCC-38	663.62	38.75	624.87
MCC-14	650.92	28.39	622.53
MCC-16	649.73	25.73	624.00
EXT-1	642.06	23.80	618.26
MCC-21R	650.98	29.30	621.68
MCC-24R	640.67	23.32	617.35
MCC-25D	645.68	29.69	615.99
MCC-30RS	636.00	26.79	609.21
MCC-36R	642.48	26.60	615.88
P-1	626.41	21.26	605.15
P-2	632.13	27.45	604.68
P-5	629.92	23.31	606.61
P-8	634.67	27.82	606.85
FP-1	605.52	2.63	602.89
MWX 3-2	633.71	27.26	606.45
OW-4	635.38	29.50	605.88
SW-1		39.18	

1/14/2003 12:12 PM
P:\22\61\003\muskegon_wlform_2.xls

Figures



LEGEND

- NEW MONITORING WELL
- POST-CERCLA EXTRACTION-INJECTION WELL
- POST-CERCLA MONITORING WELL
- PRE-CERCLA MONITORING WELL
- INACTIVE MONITORING WELL
- PROPERTY BOUNDARY
- RAILROAD
- RESIDUAL CONTAMINATION EXCEEDING TIER 2 RAGS

DATA QUALIFIERS (SEE DATABASE)

DCD	DECOMMISSIONED
DST	DESTROYED
INV	INVALID
NA	NOT ANALYZED
NI	NOT INSTALLED
NR	NOT REPORTED
NS	NOT SAMPLED
U	NOT DETECTED

150 0 150 300 450 Feet

50 0 50 100 150 Meters

Figure 1

DISTRIBUTION OF COC's
IN MILL POND CREEK AREA
4TH Quarter 2002
Muskegon Chemical
Groundwater Remediation System

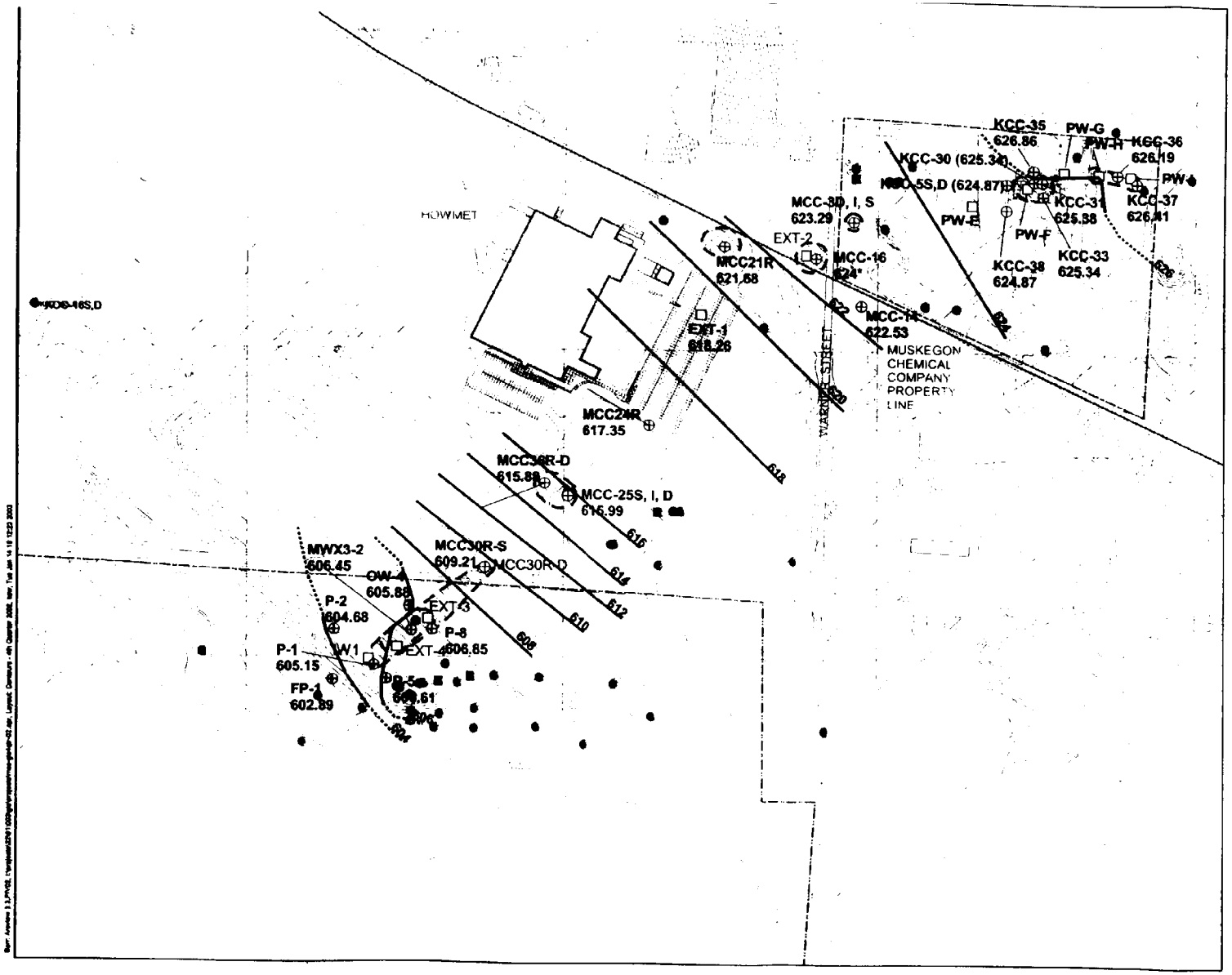


Figure 2

Contoured Hydrulic Head Data
4th Quarter 2002
Muskegon Chemical
Groundwater Renediation System

Attachment A

Model OC
0630 CALIB OF FC 5000 MULTIPARAMETER METER

PH - 7.00 READ 6.99 @ 17.69°
4.00 READ 4.00 @ 17.72°
10.00 READ 9.99 @ 17.75°

COND - 1500 READ 1502 @ 17.51°

0650 CALIB COMPLETE & SUCCESSFUL

KCC 38 + Trip Blk - 1

Refuge
0745 Arrived on Site
gathering Equip. & starting to
Set up @ KCC-38
- Generator Placed at least 75' Away From each Well
0800 S/U @ KCC-38 Trip Blank Rec.
Weather - clear, cold, ~15°F
0811 Int. Hc-38.75' Pump Set @ ~ 40'

0825 Started Purge Purge App → clear
Rec'd Set @ 142.6 Purge Rate — 24 ml/min

Purge Data - Data taken every 3-4 mins - to make sure Fresh water in flow cell

Time	0828	0831	0834	0837	0840
pH	7.10	7.15	7.19	7.20	7.20
Temp	7.94	8.18	9.60	12.63	12.82
Cond	515.7	525.2	532.2	538.7	560.0
H_2O lvl	38.75	38.75	38.76	38.76	38.76

	FINAL	
Time	0843	0846
pH	7.20	7.21
Temp	12.62	12.42
Cond	573.5	578.3
H_2O lvl	38.76	38.76

- Flow rates taken AFTER Flow Cell

AW Tot. Purge → 2.25 Gals
- Sampled @ 0847 VOC, Semi VOs Appear-Clear
- Final H_2O lvl - 38.76
- 0900 Well Locked up Closed Hasp - Broken
- 0902 - Pump Decon'd Alconox + DI H_2O

Calibration Check
Cond +- 10%
pH +- .2 Temp +- .5°C

KCC-55

0910- S/U equip @ KCC-55
0913 Int. H_2O Vol → 36.05
Resi Flo. Settle → 143.5 → 134.8
- Pump Set @ Approx 40'
0915 - Purge Started
0917 - Flow Cell Filled

Purge Rate → 2800/min
Purge Appear → clear, slight odor

Purge Data

- Readings Taken every 3 Mins for Fresh H_2O in Flow Cell

	0921	0924	0927	0930	0933	0936	0939	0942 (Final)
Time	0921	0924	0927	0930	0933	0936	0939	0942
pH	6.67	6.64	6.64	6.66	6.66	6.67	6.67	6.67
Temp	9.55	9.27	9.96	10.95	11.49	11.08	11.06	11.21
Cond	458.2	453.4	443.0	456.3	460.3	467.5	469.3	472.6
H_2O Vol	36.08	36.08	36.08	36.08	36.08	36.08	36.08	36.08

Tot. Purge → 3 Gal

0944- Sampled @ KCC-55002, Soil Vocs
0944- Final H_2O Vol → 36.08

Appear - clear, slight odor

0954- Well Closed (No Locks Present)
0956 - Pump Decon'd Soap (Alconox) DI H_2O

KCC-35

1000 S/u @ KCC 35
Init. H_2O lvl → 38.55
Rediflo Setting → 123.6 → 143.5 Purge Rate → 560 ml/m
Purge Appear → clear
Pump Set @ approx → 4'

1008 Purge Started
1011 Flow cell Filled

Purge Data - Readings taken every 3 Min.

Time	1012	1015	1018	1021	1024	1027 (Final)
pH	7.06	7.14	7.17	7.19	7.18	7.19
Temp °C	9.34	10.38	10.87	11.33	11.51	11.37
COND µs/cm	323.7	332.1	343.8	344.9	354.8	362.7
Water lvl	38.60	38.60	38.60	38.60	38.60	38.60

Tot. Purge → 2.75 gals
Sampled @ 10.28 voc, Semi Vol Appr → clear
1029 Final H_2O lvl → 38.60

1036 Well Locked
1041 Pump Decon'd Alconox + DI H_2O

MCC-3I

1100 S/H Equip @ MCC 3I +3D

MCC 3I

1114 Int. H_2O lvl → 28.20
Decon F10 S/H @ → 123.6 → 125.5 Purge Rate ~120ml/min
Pump Set @ Approx 40' Purge App → clear

1122 Purge Started
1126 Flow cell Filled

Purge Data						Final
Time	1127	1132	1138	1143	1150	1156
pH	7.35	7.37	7.62	7.78	7.81	7.86
Temp °C	7.23	6.96	5.41	3.94	3.80	3.90
Cond	373.8	376.9	395.4	406.6	414.8	419.0
Water lvl	28.78	29.13	29.59	30.17	30.40	31.18

1133 Purge Rate Approx 100ml/Min changed Reading Interval to every 6 MINS
- Note Low Temp Due to Low Flow Rate AND very cold outside Temp ~15°F

Tot Purge → .75 GAL.
Sample Taken @ 1158 VOC, Semi VOC App → clear
1158 FINAL H_2O lvl → 31.35

1205 well Locked
1207 Pump Decon'd Alconox + DI H_2O

MCC-3D

1214 S/U @ MCC-3D
INIT. H2O lvl → 27.67
Redi Flo → 125.5
Pump Set @ ~40'

Purge Rate → ~120 ml/
Purge App → clear

1216 Purge Started
1218 Flow cell Filled

Purge Data

							Final
Time	1220	1225	1230	1235	1240	1245	1250
pH	7.52	7.94	7.99	8.01	8.03	8.00	8.01
Temp °C	7.71	7.89	7.30	6.84	6.51	7.19	7.18
Cond	427.3	419.1	420.1	426.3	421.7	429.8	429.2
Water lvl	28.68	29.28	29.51	29.63	29.58	30.76	30.85

Note: Low Temp MAY Be Due to Low Purge Rate AND Cold Outside Temps ~17°F
Tot. Purge → 1 gal
Sampled @ 1252 VOC, Semi VOC Appear → clear
1252 Final H_2O lvl → 30.85

1315 Well closed no Lock
1317 Pump Decaves Alconox + DI H_2O

MCC-14

1330 S/A @ MCC-14
Int. H_2O IVI → 28.39
ReDiFlo → 127.7 → 123.7
Pump Set ~ 70

Purge → 400 ml/min
Purge App → clear

1336 Purge Started
1338 Flow cell Filled

Purge Data

Reading taken every 3 Mins

					FINAL
Time	1340	1343	~~1344~~ 1346	1349	1352
pH	8.27	8.23	8.17	8.13	8.12
Temp °C	10.53	10.11	10.38	10.59	10.64
Cond	340.3	357.4	385.4	401.6	402.4
Water IVI	30.20	30.10	30.10	30.10	30.10

Tot. Purge → 2.75 GALS
Sampled @ 1354 VOC, Semi-Voc App → clear

FINAL H_2O IVI → 30.10

1406 Well Closed - No Locks
1403 Pump Decon'd Alconox, DI H_2O

12/16/02

Ext-1

1412 S/U Ext-1
Int. H_2O lvl → 23.80
Redi Flow Setting - 114.6
Pump Set ~ 70'
Tubing Reinstalled in well

Purge Rate → 250 cc
Purge App → light brn. light brn Sed.

1417 Purge Started
1420 Flow cell Filled

Purge Data Readings taken every 3 litres

Time	1422	1425	1428	1431	1434
pH	8.07	8.10	8.14	8.16	8.15
Temp	10.44	10.55	10.76	11.00	10.88
Cond	1942	1977	1997	1994	1986
lvl	23.85	23.88	23.88	23.85	23.85 FINAL

Tot. Purge → 3 gals
Sampled @ 1436 VOC, ~~Full~~ Semi VOC App → Light Brown
Ext-1 Dup Sampled

Final H_2O lvl → 23.85

1450 Well c/o seal - only 1 oz/+ Present (stripped)
1455 Pump Decon'd Alconox to DI H_2O

MCC-241R

1509 S/L @ MCC-241R
INT H2O lvl → 23.32
RWHP @ 117.2
Pump Set @ ~80'

Purge Rate → ~600 ml/min
Purge Water → clear

1514 Purge Started
1516 Flow cell Filled

Purge Data

Time	1517	1520	1523	1526
pH	7.19	7.33	7.39	7.41
Temp	12.70	12.12	12.15	12.07
Cond	436.4	464.4	471.9	472.4
WL	23.36	23.36	23.36	23.36
				FINAL

Tot. Purge → 2.25 gal.
Sampled @ 1529 VOC, Semi VOC

FINAL H2O lvl → 23.36

1540 Well closed
1538 Pump Decon'ed Alconox + DI H_2O

12/10/02

- 1540 - 1605 - Unloaded Equip. Into Building closed Doors & Gate

Left Site @ 16:10

- Note: All Tubing Placed Back Into Well; other than Ext-1 which was Bagged & Placed in Building.

- Samples taken to Hotel

MS

MCC 36-2C
TRIP BLK #2

17DEC02 7.0 PH

0630hrs → CHECKED 10.0 PH & 1500 Cond.
10.0 READ → 10.03 @ 19.81°
1500 READ → 1497 @ 20.00°
7.0 READ → 6.97 @ 19.96°

0715 ARRIVED ON SITE
GATHERED EQUIP & STARTED TO MCC-36R FOR SETUP
Weather → clear, cold ~20°F
0740 OPENED MCC 36-2C - SETTING UP EQUIP.
0750 - TRIP BLK #2
INT. H_2O lvl → 26.60
Redic Flo Setting → 116.1 → 119.8 Purge Rate → 700 ml/min
Pump Set @ ~ ~95 Purge App → clear
0752 Purge Started
0754 Flow Cell Filled

Purge Data

Time	0754	0759	0802	0805
pH	7.45	7.44	7.43	7.44
Temp	10.67	10.99	11.09	11.08
Cond	501.4	527.7	542.1	546.4
WL	26.73	26.73	26.73	26.73
				FINAL

Tot Purge → 3.75 GAL
Sampled @ 0807 VOC, Semi Vol App → clear
FINAL H_2O lvl → 26.73
0812 Well Locked
0813 Pump Decon'ed

12/17/02 MCC-250

0833 S/U Equipe MCC 250
Int. H_2O lvl → 29.69
Redi-Flow Setting → 125.1
Pump Set ~140'

Purge Rate → ~.5 GPM
Purge App → clear/s whitish color

0838 Purge Started
0840 Flow cell Filled

Purge Data

Time	0843	0846	0849	0852
pH	8.05	8.06	8.02	7.93
Temp	10.52	10.63	10.84	11.01
Cond	438.6	439.8	442.9	449.2
WL	29.91	29.94	29.94	29.96
				FINAL

Tot. Purge → 2.5 GALS
Final H_2O lvl → 29.97
Sampled @ 0854 VOC, Semi VOC App → clear

0905 Well closed & Locked
0903 Pump Deconed Alconox + DI H_2O

12/17/02

MCC-30R-5

0914 S/U equip @ MCC 30R-5
Int. H_2O WL → ~~28.79~~ 26.79
Radflo Setting → 114.9 → 114.2
Pump Set @ 40'
Purge Rate → 600ml/min
Purge App → clear / Brn Solids

0920 Purge Started
0923 Flow cell Filled

Purge Data

Time	0927	0930	0933	0936
pH	7.54	7.53	7.54	7.51
Temp	10.75	10.96	11.19	11.39
Cond ms/cm	451.8	465.2	470.5	469.9
WL	26.81	26.81	26.81	26.81

Tot. Purge → 2.75 GALS
FINAL H_2O WL → ~~26.~~ 26.81
Sampled @ 0938 VOC, Semi Voc App → clear

0948 well closed & Locked
0945 Pump Decon'd Alconox + DI H_2O

(6)

12/12/02 MCC-21R

1017 D/G Eq. @ MCC-21 R
Init H_2O lvl → 29.30
Rediflow → 118.3
Pump Set ~ 45'

Purge Rate → 400 ml/m
Purge App → clear

1021 Purge Started
1023 Flow cell Filled

Purge Data

Time	1025	1028	1031	1034	1037
pH	7.51	7.51	7.52	7.49	7.48
Temp	8.93	10.52	11.43	11.63	11.67
COND	535.4	555.8	558.1	554.4	550.2
WL	29.33	29.35	29.35	29.35	29.35
					FINAL

Tot. Purge → 2 GACS
Final H_2O lvl → 29.35
Sampled @ 1039 voc, semi vol App → clear, no odor

1047 Well closed + Locked
1049 Pump Decon'd Alconox DI H_2O

FP-1

12/17/02 1052 Opened & closed Gate Behind us to access FP-1 etc.
1102 S/A equip @ FP-1
Init. H_2O lvl - 2.63
Radiello → 56.8 → 30.8 Purge Rate → 600 ml/min Adj → 0
Pump Set → ~10' Purge App → light Brn

1107 Purge Started
1108 Flow cell Filled

Purge Data

Time	1109	1112	1115	1118	1121
pH	7.50	7.51	7.53	7.52	7.51
Temp	9.10	9.52	9.47	9.70	9.77
Cond	570.4	569.4	571.5	570.4	571.0
WL	2.92	2.90	2.84	2.85	2.86
		*Adj. Purge Rate			FINAL

Tot. Purge → 3 Gals
Final H_2O lvl → 2.86
Sampled @ 1122 VOC, Semi VOA App → Light ish, ma Brown ~~clear~~ Clear

1128 Well closed & Locked
1130 Pump Decon'd Alconox, DI H_2O

12/17/02

P-2 MW + Tailpipe

1140 S/U equip @ P-2.
Init H_2O LVL → 27.45
Reel Flow → 117.6
Pump Set @ ~34'
Purge Rate → 600 ml/M.
Purge Appear → clear
No Odor

1146 Purge Started
1149 Flo Cell Fills

Purge Data

Time	1150	1153	1156	1159	1202
pH	7.43	7.44	7.44	7.45	7.43
Temp	9.07	10.32	11.20	11.52	11.63
Cond	663.7	623.9	621.0	626.3	633.9
WL	27.49	27.49	27.50	27.50	27.50 FINAL

Tot. Purge → 2.5 GALS
Final H_2O LVL → 27.50
Sampled @ 1204 VOC, Semi VOC Appear → clear

1215 Well closed → No Lock
1218 Pump Deconed Alconox, DI H_2O

12/17/02

1222 S/U Equip @ P-5

P-5 + Trip Blk #3

Int. H_2O level → 23.31

Reduflow → 116.5 → 109.7

Pump set → ~30'

Purge Rate → 440 ml/min

Purge Appear → clear, no odor

1226 Purge Started

1227 Flo cell Filled

Purge Data

Time	1228	1231	1234	1237	1240	1243
pH	7.42	7.41	7.40	7.42	7.42	7.42
Temp	9.49	10.01	11.06	11.49	11.71	11.77
Cond	726.5	809.1	842.9	849.0	849.8	847.1
WL	23.37	23.37	23.37	23.37	23.37	23.37
						Final

Tot. Purge → 225 Gals.

Final H_2O level → 23.40

Sampled @ 1245 VOC, Semi VOCs Appear → Clear

Trip Blk #3 1245

1300 Well Closed – No Lock on Well Cap

1303 Pump Deconed Alconox, DI H_2O

1217-02

P-1

1307 S/u Equip @ P-1
Init. H_2O lvl → 21.26
Ratio F10 → 104.5
Pump set @ ~33.0'

Purge Rate → 440 mL/M
Purge App → clear

1313 Purge Started
1315 Flo cell Filled

Purge Data

Time	1317	1320	1323	1326	1329	1332
ph	7.47	7.25	~~7.69~~ 7.13	7.45	7.44	7.45
Temp	9.04	10.10	10.98	11.35	11.59	11.70
Cond	668.9	665.3	642.4	621.0	613.2	610.8
WL	21.31	21.31	21.31	21.31	21.31	21.31
						FINAL

Tot. Purge → 2 GAL
Final H_2O level → 21.31
Samples @ 1334 VOC, Semi VOCs App → clear
No odo

1339 Well closed - No well cap Labeled 00ts; sec. well
1340 Pump Decon'ed Soap (Alconox) DI H_2O

P-8

12/17/02

1350 S/S equip @ P-8

Int. H_2O lvl → 27.82

Re di Flo → 118.0 → 116.1

Pump Set → ~40'

Purge Rate → ~500 cm/min

Purge App → clear

1359 Purge Started

1402 Flow cell Filled

1406 Joe Grant trying to get tubing out of MWX 3-2

Purge Data

Time	1405	1408	1411	1414	1417
pH	7.47	7.47	7.48	7.45	7.46
Temp	10.46	11.03	11.49	11.57	11.72
Cond	648.0	684.5	705.1	716.1	718.7
WL	27.86	27.86	27.87	27.87	27.86
					FINAL

Tot Purge → 2.5 GALS

Final H_2O level → 27.87

Sampled @ 1420 VOC, Semi VOCs App → clear

1430 Well closed + Locked. Lock sticks

1435 Pump Deconed Soap (Alconox) + DI H_2O

12/17/02 OW-4

1440 S/4 equip @ OW-4
Intial H_2O level → 29.50
- 1 1/25 Dia. well
- Used ISCO 3710 Auto Sampler Pump (Paristaltic Pump)
- New Pump Tubing Installed
- Used 1/4" IO Teflon Lined Tubing Set At A Depth of 40'
- Readings (pH, Temp, Cond. + H_2O level) were taken After each well Volume

overall Well Depth - 53.60
Initial H_2O level - 29.50
Inner Dia. of Casing = 1.25"

$(1.25)^2 (.04)(53.60-29.50) = 1.50$ gals = 1-well Vol.

1459 - Purge Started
1509 - Purge - Failed pump will not pull Head will Purge with 1/2" Poly

Time	1540	1600	1611
ph	8.09	7.92	~~8.09~~ 7.87
~~Cond~~ Temp	9.07	8.16	8.81
Cond	464.3	513.5	524.6
W.L.	30.60	29.78	30.64
GALS	1.50	3.0	4.5
Purge App →	light Brn	light Brn	light Brn

Final H_2O lvl → 30.64
Sampled @ 1615 VOC, Semi Vol Appear → cldy, light Brn/G

1625 Well Closed - tubing left in Well No Cap No Lock

12/17/02 MWX-3-2

1530 S/4 @ MWX 3-2
SOE Grout Purging OW-4
Int. H_2O lvl → 27.26
Radio Flo → 121.1 → 119.8
Pump Set @ ~ 35'
Purge Rate → ~400ml/min
Purge App → clear

1546 Purge Started
1548 Flocell Filled

Purge Data

Time	1550	1553	1556	1559	1602	1605
pH	7.54	7.48	7.45	7.45	7.44	7.42
Temp	8.31	10.14	11.25	11.48	11.52	11.53
Cond	543.5	584.8	599.3	606.0	608.4	611.2
WL	27.35	27.35	27.35	27.35	27.36	27.36 Final

Tot. Purge → 2.0 Gals
Final H_2O lvl → 27.36
Samples @ 1607 VOC, Semi VOCs App ⇒ clear

1624 well closed - Lock-Broken No Cap
1624 Pump Recovered Alconox, DI H_2O

1635 Gate closed
Heading to building to C/O Equip.

1650 Building closed

1700 Left Site Gate closed
Samples taken to Hotel
USD

18DEC02 SW-1

0620 Calib of FC5000 Multiparameter Meter

PH 4.00 → 4.01 @ 17.63°
7.00 → 7.00 @ 17.67°
10.00 → 9.99 @ 17.58°

Cond (1500) → 1501 @ 17.57°

0635 Calib Complete & Successful

JDC

Arrived @ site @ 0718
- Gathered Equip & moved on to SW-1
Weather: Rainy & 33°

12/19/02 0730 S/U @ SW-1 : (SW-1 Replaces PWF well)
Init. H_2O lvl → 39.18
- Plastic Down By Well
Pump Set ~ 50'
Rate FTO → 141.2 → 139.6 → Purge Rate → 400 mL/min
138.2
Purge App → clear
0737 Purge Started 0738 FTO cell Filled

Purge Data ← changed Reading Init. Due to Lower Purge Rate

Time	0742	0745	0750	0805	0815	0825	0835	
pH	9.41	9.40	9.40	8.98	8.62	8.43	8.27	
Temp	9.70	10.03	10.67	11.83	12.10	12.38	12.72	
Cond	259.2	262.6	264.4	290.8	351.4	388.4	401.9	tot. Purge
WL	40.84	41.58	41.46	41.60	41.40	41.39	41.37	2.75 Gals
		↓ Lowered Purge Rate to 400 mL/min					FINAL	

Final H_2O lvl → 41.37
Appears that the well will Not STAB. I. ANY BOTTLE
Sampled @ 837 VOC Sat VOC App → clear
0852 Tubing Placed in Well - No Cap Line slipped Down than this MG
0854 Pump Decon'ed Above DI H_2O approx 5'

12/18/02

KCC-30

0855 S/U Equip @ KCC-30
Init. H_2O lvl - 37.86
Redi Flo → 139.3 → 138.2
Pump Set → ~40'

Purge Rate → ~600
Purge App → clear/li
bri

0900 Purge Started
0902 Flo cell Filled
- Plastic Placed Down around Well

Purge Data

Time	0903	0906	0909	0912	0915
pH	8.21	7.26	7.08	7.05	7.03
Temp	9.99	11.26	11.69	11.78	11.86
Cond	657.6	714.4	726.4	727.2	728.1
WL	37.97	37.98	37.98	37.98	37.98

FINAL

Tot purge ~ 3 gal

Final H_2O lvl - 37.98
Sampled @ 0917 VOC, Semi-vol App → Clear

0922 Well closed + Locking Mt No Lock

0923 Pump Decon'd Alconox, DI H_2O

12/10/02
0925 s/u equip @ KCC-31

KCC-31

Int. H_2O 101 → 37.97

FlediF10 → 137.3 → 136.37 → 135.2 Purge Rate → 400 ml/min

Pump Set → ~40 Purge App → clear, very light brn

0928 Purge Started

0929 Flocell Filled

- Plastic. Down Range Well

Purge Data

Time	0931	0934	0937	0940
pH	7.82	7.47	7.34	7.27
Temp	9.77	11.22	11.63	12.06
Cond	738.2	740.8	738.2	736.3
WL	38.03	38.06	38.06	38.07 FINAL

Tot. Purge 2 GALS

FINAL H_2O 101 - 38.07

Sampled @ 0943 VOC, Semi VOC App → clear

0950 Well closed

0952 Pump Decon'd Alconox, DIH_2O

KCC-33

12/10/02
0955 s/u equip @ KCC-33
Trip Blk #

Int. H_2O VOL → 36.28
Redi Flow → 136.0
Pump Set → ~ 39'

Purge Rate → ~560 ml/
Purge App → Light
Color - No

Plastic Placed around well

0958 Purge Started
0959 Flow cell Filled
1005 Trip Blk #4

Purge Data

Time	1000	1003	1006	1009	1012	1015
pH	6.64	6.63	6.67	6.68	6.67	6.69
Temp	10.60	11.34	12.37	12.99	13.12	13.36
Cond	363.4	385.7	440.9	477.6	495.4	478.7
WL	36.32	36.32	36.32	36.32	36.32	36.32
						Final

Tot. Purge → 2.5 Gals
Final H_2O VOL → 36.32

Sampled @ 1017 - VOC, Semi VOCs App → clear

1026 - Well closed, No Lock

1025 Pump Decon'ed Alconox, DI H_2O

KCC-37

1040 S/u equip @ KCC-37
Int. H_2O 101 → 38.35
Reoiflo → 134.8
Pump Set → ~40'

Purge Rate → 520ml/min
Purge App → clear

- Steady Rain, Cool

1046 Purge Started
1049 Flo cell Filled

Purge Data

Time	1051	1054	1057	1100
pH	6.08	6.11	6.13	6.13
Temp	10.98	12.45	12.62	12.53
Cond	81.9	103.0	109.9	111.3
WL	38.40	38.40	38.40	38.39
				Final

Tot Purge 1.5 Gals
Final H_2O 101 - 38.37

Sampled @ 1103 VOC, Semi VOCs App → clear
No odor

1111 Well closed, & Locked Tubing Falling Down Inside well

1112 Pump Decon'd

12/18/02 KCC-3

1118 S/A equip @ KCC-36

Init. H_2O lvl → 38.53

Read FIO → 137.2

Pump Set → 240'

Purge Rate → 440ml/m

Purge App → clear

1124 Purge Started

1127 Flow cell Filled

Purge Data

Time	1129	1132	1135	1138	1141	1144
pH	6.25	6.30	6.30	6.32	6.33	6.33
Temp	10.20	12.02	12.94	13.39	13.53	13.61
Cond	147.9	160.7	165.1	168.7	171.4	172.7
WL	38.57	38.56	38.59	38.58	38.58	13.58
						Final

Tot. Purge → 2.06gal

Final H_2O lvl → 13.58

Sampled @ 1146 VOC, Sem-Vol App → CLEAR

1157 Well closed & Locked

1158 Pump Deconed Alconox + DI H_2O

12/18/02

1247 - Going Back to Building to gather Equip & Finalize Paperwork

1305 Calib Check

1500 µS/cm SPC Read 1486 @ 13.47°C

PH 4.00 Read 4.05 @ 23.87°
7.00 Read 7.02 @ 23.63°
10.00 Read 9.98 @ 23.88°

✓ Calib Completed @ 1355

Checked Coolers & Packed For Shipping
1455 hrs.

Loaded Truck & Cleaned up Scopes
1525 hrs.

Headed for Motel @ 1530 hrs. Building closed up & Gate Closed

C.O.C.'s Made out in Motel.

DS & MSR

ATTACHMENT 4
MDEQ OPERATIONAL MEMORANDUM #17

September 8, 1998

TO: All Environmental Response Division Staff

FROM: Alan J. Howard, Chief, Environmental Response Division

SUBJECT: **Environmental Response Division Operational Memorandum #17**: Instructions for Obtaining Determinations on Mixing Zone-Based Groundwater Surface Water Interface Criteria for Inclusion in Remedial Action Plans and Monitoring Compliance with Criteria for Discharges of Groundwater Contaminants to Surface Water

THIS OPERATIONAL MEMORANDUM HAS BEEN PREPARED TO FACILITATE IMPLEMENTATION OF THE 1995 AMENDMENTS TO PART 31, WATER RESOURCES PROTECTION, AND PART 201, ENVIRONMENTAL REMEDIATION, OF THE NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION ACT, 1994 PA 451, AS AMENDED.

Introduction

The location at which groundwater enters a surface water body is commonly referred to as the groundwater/surface water interface (GSI). This Operational Memorandum describes the information required and the process for requesting determinations regarding criteria to be met at the GSI for contaminated groundwater discharges to surface water.

Section 20120a(15) of Part 201, Environmental Remediation, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA), requires that if a Remedial Action Plan (RAP) allows for discharges of groundwater venting from a facility to the surface water then the discharge must comply with the requirements of Part 31, Water Resources Protection, of the NREPA and the rules promulgated under that Part. Section 3109a(1) of Part 31 allows for mixing zones for discharges of venting groundwater in the same manner as for point source discharges, except that no permit is required where mixing zones are provided for in an approved RAP. Where a mixing zone has not been provided for in an approved RAP or permit, the groundwater quality at the GSI must meet the "generic GSI criteria." (Generic GSI criteria are listed in column #3 in the table of "Groundwater: Residential and Industrial-Commercial, Part 201 Generic Cleanup Criteria and Screening Levels" available from the Environmental Response Division [ERD] of the Department of Environmental Quality [DEQ]. This table is also available on the DEQ, ERD Internet homepage at www.deq.state.mi.us.)

Mixing zones for venting groundwater contaminant plumes may be most appropriate to consider in situations where bioaccumulative contaminants are not present, source materials are controlled, the nature and extent of soil and groundwater contamination are adequately defined, and contaminant concentrations are less than final acute criteria at the GSI. (Final acute criteria are listed as FAV's in the table of Rule 323.1057 Water Quality Values available from the Surface Water Quality Division [SWQD] of the DEQ. This table is also available on the DEQ, SWQD Internet homepage at www.deq.state.mi.us. Bioaccumulative compounds are identified in Table 5 of Rule 323.1057 of the Part 31 Rules.)

Rule 323.1098 of the Part 31 Rules requires that waters of the state which are of better quality than the water quality standards not be allowed to be degraded by a "new or increased discharge" unless there is an "antidegradation demonstration" or it is demonstrated that the discharge is exempt under Rule 323.1098(7) or (8). Where a groundwater contaminant plume with concentrations above the generic GSI has not yet reached the surface water or where groundwater contaminant concentra-tions entering the surface water will increase significantly, it will be considered to be a new or increased discharge. Therefore, in such circumstances, in order to obtain mixing zone-based GSI criteria an antidegradation demonstration or a demonstration of qualification for an exemption will be required. An antidegradation demonstration must show that the discharge would be in the public interest based on social or economic benefit to the area in which the new or increased discharge will occur. The information required to make the antidegradation demonstration is outlined in Attachment A. Where the new discharge includes bioaccumulative contaminants no mixing zone will be allowed. Where concentrations will increase in an existing discharge, which contains bioaccumu-lative compounds, alternatives to eliminate or significantly reduce them in the discharge must be evaluated as specified in Attachment A.

Determining Mixing Zone-Based GSI Criteria

In order to obtain a determination of "mixing zone-based GSI criteria" for a discharge of contaminated groundwater to be covered by a RAP, the District Supervisor or Unit Chief will submit a request for a mixing zone determination to the Field Operations Supervisor. The Field Operations Supervisor will assign the appropriate priority to the request and then forward it to the SWQD, Great Lakes and Environmental Assessment Section. Any party requesting a mixing zone determination must provide the following information to the ERD for evaluation:

1) The name (if any) of the receiving surface water body and the location of the venting groundwater plume.
2) The location, nature, and chemical characteristics of past and ongoing source(s) of the groundwater contaminant plume.
3) The name, Chemical Abstract Service (CAS) Number, and concentration of the contaminants in the groundwater contaminant plume at the GSI and upgradient of it to the source area.
4) The discharge rate in cubic feet per second (cfs) of the venting groundwater contaminant plume (the discharge rate of the groundwater plume should be calculated using that portion of the contaminant plume which is or may become contaminated at concentrations above the generic GSI).
5) The location of other contaminant plumes entering the same surface water body in the vicinity of the facility and their constituents and concentrations, if available.
6) If this is a "new or increased discharge," an explanation of the social or economic benefits to the area that would be foregone if the discharge is not allowed.
7) If bioaccumulative contaminants are in the "new or increased discharge," a description of alternatives to eliminate those contaminants from the discharge.

A form memorandum for ERD's submittal of a request for a mixing zone determination is found as Attachment A. To assure that valid information is provided in a mixing zone determination request, some or all of the information described in Attachments A and B need to be evaluated by ERD staff. Due to the individual circumstances of sites of environmental contamination, not all of the information outlined in Attachment B will be required in every case. Professional judgment should be used on a case by case basis to determine what will be necessary to derive the information required for the request for mixing zone determination.

The SWQD is responsible for supplying the remaining information necessary to perform the mixing zone determination. This includes information on the flow and quality of the receiving surface water body, any other pertinent point and non-point source discharges, and the total loading of contaminants to the surface water body. The SWQD will determine the allowable mixing zone-based GSI criteria for the contaminants in the venting groundwater. Chronic criteria are calculated based on dilution and other contaminant loadings in the surface water body in order to meet water quality criteria after mixing. Final acute criteria are calculated as maximum concentrations not to be exceeded at the GSI in order to prevent immediate harm to aquatic life. These will be calculated on a contaminant and site-specific basis. The resulting mixing zone-based GSI criteria will then be forwarded by SWQD to the appropriate District Supervisor or Unit Chief, with a copy to the Field Operations Supervisor, for incorporation into the RAP.

Parties seeking a mixing zone determination should submit a request and supporting documentation to the appropriate ERD District Supervisor, Unit Chief, or analogous personnel in another Division overseeing or having regulatory authority over the response action. These will then be reviewed and forwarded as appropriate through the Field Operations Supervisor to the SWQD, Great Lakes and Environmental Assessment Section. When the information necessary to make a mixing zone determination has been submitted to the department, a determination will be made within six months. The determination will be forwarded to the requester after it is received by ERD. Parties may ask to meet with staff of ERD, SWQD, and/or other involved divisions to discuss their request prior to submittal, during the evaluation, or after a determination has been made.

In limited circumstances, chemical-specific criteria may not be protective of aquatic life due to the number or nature of toxic substances and/or unidentified substances found in the venting contaminant plume. Toxicity testing of the groundwater contaminant plume may also be required. This testing will be similar to the whole effluent toxicity testing required for certain point source discharges. The SWQD will specify any requirements for such testing in the mixing zone determination.

In some instances it may be helpful to obtain preliminary mixing zone-based criteria prior to development of a RAP. Parties considering obtaining a mixing zone determination for a site can request a preliminary mixing zone determination by providing preliminary information for evaluation and specifying that it is a "preliminary request prior to RAP submittal." When submitting the request to SWQD, ERD should also indicate on Attachment A that this is a preliminary request prior to RAP submittal. A party may instead choose to estimate the mixing zone-based GSI criteria by following Rules 323.1041 through 323.1117, Part 4, and Rules 323.1201 through 323.1221, Part 8, of the Part 31 Rules. Regardless, the final mixing zone-based GSI criteria will be established by the SWQD and approved by the ERD as part of a RAP.

For certain chemicals and for stream segments with waste load allocations, the dilution afforded by the surface water body may not be the limiting factor in determining mixing zone-based GSI criteria because the assimilative capacity of the stream segment has been reached for specific contaminants. Attachment C provides a list of stream segments with waste load allocations and the specific contaminants effected. Dilution will not generally be permitted to adjust generic GSI criteria for polychlorinated biphenyls (PCBs) or mercury because the concentrations, which would be protective of aquatic life, are below detection limits, even where substantial dilution will occur. In addition, other bioaccumulative compounds are required to be phased out of discharges within seven years. It may be advantageous to evaluate the potential for PCBs, mercury, or other bioaccumulative chemicals to be of concern at a site and/or test for their presence early on. This will allow for a reasonable evaluation of the value of pursuing mixing zone-based GSI criteria.

It should also be recognized that in accordance with Rule 323.1082(5) of the Part 31 Rules groundwater contaminant plumes venting into lakes will not be allowed a dilution factor greater than ten

parts receiving water to one part venting groundwater for the development of mixing zone-based GSI criteria. In some situations a lesser dilution factor than ten to one will be allowed based on site-specific circumstances.

Parties may seek alternate mixing zone-based GSI criteria by submitting a demonstration that they are appropriate in accordance with Rule 323.1082(7) of the Part 31 Rules.

Determining Monitoring Requirements

Mixing zone-based GSI criteria will be identified by the SWQD as either chronic or final acute criteria. A monitoring schedule must be approved by the DEQ and specified in the approved RAP for the facility.

Extended monitoring of the GSI will not be necessary when it is demonstrated that the venting groundwater will always comply with the GSI criteria (whether they are generic criteria or mixing zone-based criteria). In other situations, a method must be established to ensure that groundwater venting to the surface water body meets the established GSI criteria. Generally, this will be accomplished in two ways. First, through monitoring of the groundwater at compliance monitoring points and, where possible, sentinel monitoring points [in compliance with Section 20118(10)(a), (b), and (c) of the NREPA]. And secondly, through implementation of contingent remedial action where needed to prevent harm to human health, wildlife, or aquatic like from exceedances that are predicted or have occurred. In the event that exceedances are predicted or have occurred, compliance monitoring plans may call for increased monitoring, evaluation of the severity of any exceedance and evaluation of the need to implement further remedial actions. Facility-specific requirements for compliance monitoring and contingency plans, if required, must be specified in the RAP. Further discussion on compliance monitoring plans and contingency plans is found in Attachment D.

Groundwater samples should be representative of the chemistry of groundwater within the contaminant plume discharging to the surface water. Groundwater concentrations should be measured in the groundwater contaminant plume or in the path of the contaminant plume to establish compliance with either generic or mixing zone-based GSI criteria. These measurements should be taken as close to the surface water body as feasible, where and when groundwater gradients show that the groundwater is moving toward the surface water body. GSI compliance monitoring points should generally be in locations where groundwater is not normally recharged by the surface water (i.e., where periodic flooding and associated bank storage is not a factor). Static water levels in the surface water and groundwater should be determined for each sampling event. In addition, the monitoring plan may require determination of the groundwater flow direction for each sampling event or at some other specified frequency. In certain circumstances groundwater modeling may be a useful tool for making certain decisions.

The cross sectional area of the contaminant plume used for averaging monitoring results for compliance with the chronic mixing zone-based GSI criteria should generally be the same as that used to estimate the discharge rate of the venting groundwater indicated in the request for a mixing zone determination and will generally consist of that portion of the groundwater where contaminants exceed or are expected to exceed the generic GSI criteria. The area of the contaminant plume to be monitored for compliance with mixing zone-based GSI criteria (compliance area) must be defined in the RAP for each contaminant for which mixing zone-based criteria have been determined. This may result in multiple compliance areas being identified for the venting contaminant plume. An example where this could occur would be where contaminants with different specific gravities such as benzene and trichloroethylene are present in the groundwater plume at different depths in the aquifer. Depending on facility-specific circumstances, it may be necessary to adjust the monitoring points used to judge compliance with mixing zone-based GSI criteria during implementation of the RAP. Factors to be considered are discussed in Attachment D.

Evaluating Compliance

For each sampling event, the average of the contaminant concentrations in groundwater samples taken from monitoring points within the contaminant plume in the areas selected for GSI compliance monitoring must not exceed the chronic criteria for the area(s) of the contaminant plume defined for monitoring compliance. Data used to calculate the average concentrations should only include data from monitoring points within the areas specified in the RAP as described above.

The final acute criteria should not be exceeded at the GSI. Any exceedances of final acute criteria should be promptly evaluated to determine their significance and potential harm to aquatic life and to determine if any further remedial action is needed, as described in Attachment D.

Contacts For More Information

General questions about this memorandum or requesting mixing zone determinations should be directed to ERD District Supervisors for Part 201 sites or Claudia Kerbawy, 517-335-3397, the Superfund Section Chief for National Priorities List sites. A map identifying ERD districts, supervisors, addresses, and telephone numbers is found in Attachment E.

This memorandum is intended to provide guidance to Division staff to foster consistent application of Part 201 of the NREPA and associated Administrative Rules. This document is not intended to convey any rights to any parties nor create any duties or responsibilities under law. This document and matters addressed herein are subject to revision.

Attachments

September 8, 1998

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

INTEROFFICE COMMUNICATION

_____
(Date)

TO: [William Creal (for facilities in Southern Lower Peninsula)
Gerald Saalfeld (for facilities in Northern Lower Peninsula and Upper Peninsula)]
Great Lakes and Environmental Assessment Section
Surface Water Quality Division

FROM: Daniel Schultz, Field Operations Supervisor
Environmental Response Division

SUBJECT: _____ (Facility name)
Mixing Zone Determination Request
_____ District

We are requesting a mixing zone determination for the above referenced facility, located in the ____1/4 of the ____1/4 of Section ____, T_____, R_____ in _____County.

Priority: [ ] 1 (4 week response)
[ ] 2 (8 week response)

Project Manager: _____ Phone #: _____

District Supervisor / Unit Chief: _____

Phone #: _____ FAX #: _____

The facility characteristics include:

1. The name of the receiving water body and the location of the venting groundwater contaminant plume (map attached). This is a [ ] new [ ] increased or [ ] existing loading.

2. The location, nature, and chemical characteristics of the source of the groundwater contamination plume: (Please note that landfill or other leachate, which is above the groundwater table, such as leachate in a collection system, should be identified here as a source.)

3. The name, Chemical Abstract Service (CAS) Number, and worst case maximum concentration of contaminants predicted to reach the groundwater/surface water interface (GSI). Generally the highest concentration of the contaminant found in the groundwater would be appropriate to represent the worst case maximum. If source contaminants have not yet reached the groundwater but are expected to do so, source concentrations should be identified and noted as such. Mixing zone-based GSI criteria will not be developed for contaminants that are not identified as having a reasonable potential to exceed water quality criteria. For contaminants that do not have mixing zone-based GSI criteria, the generic GSI criteria will apply. Attach additional sheets, if necessary.

Chemical or General Chemistry Parameter	CAS #	Predicted Worst Case Maximum GSI Discharge Concentration	Average Surface Water Conc. Upstream If available

4. The discharge rate of the venting groundwater contaminant plume in cubic feet per second (cfs).

5. The location of other contaminant plumes entering the receiving surface water body, their constituents and concentrations, if available:

6. The lowest monthly 95 percent exceedance low flow at the discharge location: _____CFS
   The harmonic mean flow at the discharge location: _____CFS
   The 90dQ10 flow at the discharge location: _____CFS
   [ ] has been determined by the Hydrologic Studies Unit of the Land and Water Management Division (memo attached).
   [ ] as indicated in the Land and Water Management Division Low-Flow Data Base.
   [ ] has been requested from the Hydrologic Studies Unit of the Land and Water Management Division.
   [ ] has not yet been determined.

If this is a new loading, or increased loading above previously authorized levels, an antidegradation demonstration, which includes the information in 8 and 9 below, or a demonstration of qualification for an exemption under Rule 323.1098 (7) or (8), is required.

7. Please check whether there is
   a) ___ an antidegradation demonstration (Fill out 8 and 9.) or
   b) ___ a demonstration of qualification for an exemption (Refer to 323.1098 (7) and (8) for elements needed for this demonstration.)

   Please identify below who prepared the antidegradation or exemption demonstration.

Name	Division/Agency/Company

8. This is a new or increased loading from venting groundwater. The social or economic development and the benefits to the area in which the waters are located that would be foregone if the new or increased discharge is not allowed include:

- Employment increases:
- Production level increases:
- Employment reductions avoidance:
- Efficiency increases:
- Industrial, commercial, or residential growth:
- Environmental or public health problem corrections:
- Economic or social benefits to the community:
- Other relevant factors:

If the new or increased loading includes the following bioaccumulative chemicals of concern (BCCs), Chlordane, 4,4'-Dichlorodiphenyldichloroethane, 4,4'-Dichlorodiphenyldichloroethylene, 4,4'-Dichlorodiphenyltrichloroethane, Dieldrin, Hexachlorbenzene, Hexachlorobutadiene, Hexachlorocyclohexanes, alpha-Hexachlorocyclohexane, beta-Hexachlorcyclohexane, delta-Hexachlorocyclohexane, Lindane, Mercury, Mirex, Octachlorostyrene, Polychlorinated biphenyls, Pentachlorobenzene, Photomirex, 2,3,7,8-Tetrachlorodibenzodioxin, 1,2,3,4-Tetrachlorobenzene, 1,2,4,5-Tetrachlorobenzene, Toxaphene, complete the following:

9. BCCs are included in the discharge. The alternatives evaluated and the alternatives to be implemented that will comply with minimizing the discharge of the BCC by implementation of any cost-effective pollution prevention alternatives (such as source control) and techniques reasonably available that would eliminate or significantly reduce the discharge of the BCC are:

If pollution prevention alternatives would not eliminate the increased discharge of the BCC, the person making the demonstration shall evaluate alternative or enhanced groundwater treatment techniques that would eliminate the discharge of the BCC. The techniques that have a cost that is reasonable relative to the cost of treatment necessary to achieve generic GSI criteria shall be implemented. The alternatives evaluated and the alternatives to be implemented that will comply with this requirement are:

Basis for Information to be Considered in Mixing Zone Determinations

The following information should be provided to and/or evaluated by DEQ staff as appropriate. Not all of this information will be needed in every case. Best professional judgment should be used on a case-by-case basis in determining what is necessary to derive the information requested in Attachment A. This is intended to be a fairly comprehensive listing of what should be considered in gathering and evaluating information related to discharges of groundwater to the surface water. It is not expected that all of the information discussed in this attachment will need to be evaluated in all cases. In general, only that information identified on Attachment A will need to be forwarded to the SWQD when submitting a request for a mixing zone determination. Other factors described here may need to be evaluated by DEQ staff to assure that the information provided to SWQD in Attachment A is complete and accurate.

1. **Receiving Surface Water Body and Location of the Venting Groundwater Plume(s)**

   - This information should be supplied in narrative and map form.

2. **Location, Nature and Chemical Characteristics of the Source of the Groundwater Contaminant Plume**

   - A map(s) should be provided which show(s), at a minimum:
     - The receiving surface water body or bodies and the property and facility boundaries.
     - Buildings and other structures on the property where the plume originates and under which the plume migrates.
     - The location of sources of contamination.
   - Information should be provided on the following:
     - The location and nature of the source or sources of contamination, and if removed or still present.
     - The type of source contaminants and their chemical characteristics and concentration.
     - The mobility of the contaminants.
     - The amount of recharge from precipitation over the source area in inches/year. (This information may be obtained from the Hydrologic Studies Unit of the Land and Water Management Division using the form memorandum found in Attachment F.) When calculating the amount of recharge, consideration should be given to the amount of impervious surface that exists over the source area.

3. **Name, CAS Number, and Concentration of the Contaminants in the Groundwater Contaminant Plume at the GSI and Upgradient from the GSI to the Source Area**

   - A map(s) indicating, at a minimum:
     - The locations of monitoring wells and borings.
     - The location of the contaminant plume in plan view (where appropriate, concentration contours should be shown for individual contaminants or groups of contaminants).
     - Cross-sections of the contaminant plume, as close to the receiving water body as possible to show the nature of the plume as it enters the surface water body. (See note above on contouring.)

   - The following information should be provided for each plume:
     - The name and CAS number of contaminants and other parameters present in the contaminant plume (CAS numbers can be obtained from a variety of sources, including

chemical dictionaries and the National Institute of Occupational Safety and Health Pocket Guide to Chemical Hazards).

- The presence of any dense or light non-aqueous phase liquids (DNAPLs or LNAPLs).
- Contaminant concentrations from the source area to the GSI.
  - To characterize the contaminant concentrations at the GSI, representative
  - groundwater samples should be gathered as close to the surface water body as feasible without being impacted by recharge from the surface water body (i.e., the hydraulic gradient should be toward the surface water body during sampling.)
  - Maximum concentrations should be identified for individual groundwater and source area contaminants.
  - Groundwater samples should be representative of the water moving through the aquifer in the contaminant plume. The United States Environmental Protection Agency's (EPA) low-flow sampling protocol (purging and sampling using a flow rate of 100-500 ml/min) should be used if feasible. Other sampling methodologies may be approved if use of the low flow protocol is not feasible and it can be demonstrated that they will be as effective in characterizing the parameters of concern as the low-flow methodology. Samples should not be filtered unless it is not feasible to collect samples that have turbidity that is representative of the water flowing in the aquifer. In that situation both filtered and unfiltered samples should be collected for inorganic analysis. Samples to be analyzed for organic substances should not be filtered regardless of sample turbidity. In most instances a 0.45 micron filter will be appropriate; although site-specific circumstances may require larger filters to collect representative samples.
  - Analyses should be performed for general chemistry parameters, such as major cations and anions, ammonia, chemical and biological oxygen demand, chlorides, and phosphorous, where they are likely to be elevated. (These water quality parameters have not traditionally been evaluated at sites of environmental contamination, but are of particular concern where an impact to surface water may occur. Landfills are an example of facilities where many of these parameters may be of concern.)
  - Where previously collected data exists that does not conform to the above specifications, the data could be evaluated to determine whether it is suitable for site evaluation and mixing zone determinations or whether it is necessary to acquire additional data.
  - Predicted worst case maximum GSI discharge concentrations should be developed and identified where concentrations of contaminants at the GSI may increase.

4. **Discharge Rate of the Venting Groundwater Plume (Based on the Hydrogeological Characteristics of the Source Area and Along the Path of the Plume to the Surface Water Body)**

- The geology of the area of the contaminant plume(s) should be defined to the extent necessary to understand the impact of the groundwater discharge to surface water. This may include consideration of:
  - Materials in the saturated zone (e.g., sands, silts, clays, sandstone, limestone, granite, and fill).
  - Factors which may impact contaminant transport, such as the amount of organic carbon, available nutrients and overall chemical composition of materials in the saturated zone.
  - Stratigraphy of the facility.
  - Confining lenses or layers.
  - Geologic structures such as faults, fractures, and buried glacial valleys.

- Geomorphology and topography of the facility.

- The hydrogeology of the area of the contaminant plume(s) should be defined to the extent necessary to understand the impact of the groundwater discharge to surface water. This may include consideration of:
  - The uppermost aquifer or saturated zone present below the facility.
  - The thickness and elevations of the aquifer(s) and/or saturated zone(s).
  - Direction(s) of groundwater flow (shown on a potentiometric contour map).
  - Groundwater discharge and recharge patterns at the facility.
  - Horizontal and vertical flow gradients in the aquifer(s) and/or saturated zone(s), particularly in the area adjacent to the surface water body.
  - Any seasonal changes in flow directions represented on groundwater potentiometric contour maps (this requires that several samples be taken over the course of the year in wet and dry seasons).
  - Transmissivity or hydraulic conductivity and effective porosity of the aquifer(s) and/or other saturated zone(s).
  - Specific yield, storativity, and specific storage of the aquifer(s) and/or other saturated zone(s).
  - The portion of the groundwater plume(s) discharging to the surface water body and/or flowing under the surface water body, and any seasonal changes that occur.
- Based on the hydrogeologic information described above and the characteristics of the plume as it enters the surface water body, calculate the discharge rate in cubic feet per second (cfs), for the portion of the groundwater plume contaminated above the generic GSI criteria that is discharging to the surface water.
- Where applicable, use maps to illustrate the above information both in plan and cross-sectional view.

5. **Location of Other Known Contaminant Plumes Entering the Same Surface Water Body, Their Constituents and Concentrations (if available)**

   - On a map, identify the location of the subject groundwater discharge plume and the location of any other contaminant plumes entering the same surface water body in the vicinity of the facility, if known.
   - Identify the contaminants contained in the other plumes and their concentrations, if known.
   - Information on other contaminant plumes may be available from the ERD district office or other local sources.

September 8, 1998

WASTELOAD ALLOCATIONS*

The following waterbodies and facilities have been identified as involved in Wasteload Allocations where more than one facility is considered when performing the allocation.

Receiving Water	County	Facility	Permit #	Parameter
Black River	Sanilac	Aunt Jane Foods		CBOD
		Croswell WWTP	MI0021083	Ammonia
		Mich Sugar Co-Croswell	MI0002542	
Cass River	Saginaw	Bridgeport Twp. WWTP	MI0022446	CBOD
		Frankenmuth WWTP	MI0022942	Ammonia
		Vlasic Foods-Bridgeport	MI0001651	
Clinton River	Oakland	Pontiac WWTP	MI0023825	CBOD
	Macomb	Rochester WWTP	MI0023931	Ammonia
		Warren WWTP (via Red Run Drain)	MI0024295	
Detroit River	Wayne	Detroit WWTP + several	MI0022802	Cadmium
				Lead
Fish Creek	Montcalm	Carson City WWTP	MI0020192	CBOD
		Crystal Refining	MI0002801	Ammonia
Flint River	Genesee	Flint WWTP	MI0022926	CBOD
		Flushing WWTP	MI0020281	Ammonia
		Genesee Co-Ragnone WWTP	MI0022977	
Ford/Belleville Lakes	Washtenaw	Ann Arbor WWTP	MI0022217	Phosphorus
		Chelsea WWTP	MI0020737	
		Dexter WWTP	MI0022829	
		Loch Alpine WWTP	MI0024066	

Receiving Water	County	Facility	Permit #	Parameter
Grand River	Ingham	Lansing WWTP	MI0023400	CBOD
		Delta WWTP	MI0022781	Ammonia
Grand River	Kent	Grand Rapids WWTP	MI0026069	Metals
		Grandville WWTP	MI0023027	CBOD
		Wyoming WWTP	MI0024392	
Grand River	Ottawa	Grand Haven WWTP	MI0021245	CBOD
		Eagle Ottawa Leather Co.	MI0050253	Ammonia
Hayworth Creek	Clinton	Federal Mogul		CBOD
		St. Johns WWTP	MI0026468	Ammonia
Kalamazoo River	Kalamazoo	Kalamazoo WWTP	MI0023299	CBOD
		Simpson Plainwell Paper	MI0003794	Ammonia
Kent Lake	Oakland	Wixom WWTP	MI0024384	Phosphorus
		Ford-Wixom	MI0028151	
Limekiln Lake	Oakland	South Lyon WWTP	MI0020273	Phosphorus
		Quanex Corp-MI Seamless Tube	MI0001902	
Muskegon Lake	Muskegon	Muskegon WWTP	MI0029173	Phosphorus
		MDNR-ERD/Ott/Story	MI0053309	
Paw Paw River	VanBuren	Paw Paw Lake WWTP	MI0023779	CBOD
		Fletcher Paper	MI0000817	Ammonia
Pine River	Gratiot	Total Petroleum	MI0001066	CBOD
		Alma WWTP	MI0020265	Ammonia
		St. Louis WWTP	MI0021555	

September 8, 1998

Receiving Water	County	Facility	Permit #	Parameter
Rouge River	Wayne	Rouge Steel	MI0043524	Cadmium
		Double Eagle Steel	MI0044415	Lead
		Power and Utility	MI0050903	
Saginaw River	Bay	Bay City WWTP	MI0022284	Ammonia
		Essexville WWTP	MI0022918	
		West Bay County WWTP	MI0042439	
Salt River	Macomb	Richmond WWTP	MI0023906	CBOD
		New Haven Foundry	MI0038032	Ammonia
Swan Creek (Drain 30)	Branch	Bronson WWTP	MI0020729	CBOD
		Bronson Plating	MI0000825	Ammonia
		Douglas Autotech	MI0005720	Copper
				WET
				Phosphorus
Swan Creek	Monroe	City Sand & Landfill		CBOD
		Holiday Woods MHP	MI0043079	Ammonia
		Carleton WWTP	MI0022543	
		Guardian Ind.	MI0037001	(not considered for CBOD & Ammonia)
		Flat Rock MHP	MI0025844	
Tittbawassee River	Midland	Dow Chemical-Midland	MI0000868	TDS
		Midland WWTP	MI0023582	Ammonia
		Midland Cogeneration Venture	MI0042668	

ACRONYMS:
CBOD - Chemical and Biological Oxygen Demand WET - Whole Effluent Toxicity TDS - Total Disolved Solids

* Please note that this table is current as of February, 1996. Current information on waterbodies having Wasteload Allocations can be obtained from the Surface Water Quality Division, Great Lakes and Environmental Assessment Section.

Compliance Monitoring and Contingency Plans

Extended monitoring of the GSI will not be necessary when it is demonstrated that the venting groundwater will always comply with the GSI criteria (whether they are generic criteria or mixing zone-based criteria). In other situations, a method must be established to ensure that groundwater venting to the surface water body complies with established GSI criteria. Generally, this will be accomplished in two ways. First, through monitoring and evaluation of results of monitoring of the groundwater at compliance and, where possible, sentinel monitoring points [in compliance with Section 20118(10)(a), (b), and (c) of the NREPA]. And secondly, through implementation of further remedial action where needed to prevent harm to human health, wildlife or aquatic life from exceedances that are predicted or have occurred. Facility-specific requirements for compliance monitoring and contingency plans must be included in the approved Remedial Action Plan (RAP). Because of the difference in objectives and methods, locations for compliance monitoring may differ from locations for monitoring done as a part of investigating a site. Monitoring and contingency plans may include the following, as appropriate to the site.

1. Monitoring Plans

- Monitoring plans should identify the portion of the contaminant plume to be monitored for compliance with mixing zone-based GSI criteria as defined in the RAP. This will generally consist of that portion of the groundwater where contaminants exceed or are expected to exceed the generic GSI criteria. Compliance areas should be specifically identified in the monitoring plan for each contaminant for which mixing zone-based criteria have been determined. This may result in multiple compliance areas being identified for the venting contaminant plume. The cross section(s) of the contaminant plume used for averaging monitoring results for compliance with the chronic mixing zone-based GSI criteria should generally be the same as that used to estimate the discharge rate of the venting groundwater indicated in the request for a mixing zone determination. Depending on facility-specific circumstances, it may be necessary to adjust the monitoring points used to judge compliance with mixing zone-based GSI criteria during implementation of the RAP. Factors to be considered include:
  - Movement, expansion, or shrinkage of the contaminant plume.
  - Changes in concentration of contaminants in the plume.
  - Changes in the contaminants present in the plume.
  - New information clarifying the location, concentration, or contaminants present in the contaminant plume and/or at the GSI.
- Monitoring plans should include a map of monitoring points and well screen depths in both plan and cross-sectional view. Both GSI compliance monitoring points and sentinel monitoring points should be identified, as appropriate.
  - Compliance monitoring points should be located in the groundwater contaminant plume, or in
  - the path of the contaminant plume, as close to the surface water body as practical without being influenced by recharge from the surface water body (groundwater gradients, determined from static groundwater and surface water elevations, should be toward the surface water body during sampling events). The GSI compliance monitoring points should generally be in locations where groundwater is not normally recharged by the surface water (i.e., where seasonal flooding and associated bank storage is not a factor). Monitoring point locations and sampling events should be adequate to identify any seasonal migration or other variation in the groundwater contaminant plume.
  - Sentinel monitoring points should be located downgradient of the source of the groundwater contamination and far enough upgradient of the surface water body to allow any necessary further remedial actions to be implemented prior to exceedances of the relevant GSI criteria at the GSI. The need for sentinel monitoring points will be dependent on whether the source of the groundwater contamination has been removed and whether there are, or is the potential for, significant variations in the contaminant concentration upgradient of the GSI. Where sources of contamination are in close proximity or adjacent to the surface water body,

this approach will need to be modified as appropriate to the site-specific circumstances.

- Monitoring plans should identify methods to be used for sampling and analysis. Groundwater samples should be representative of water migrating through the aquifer within the groundwater plume. The EPA's low-flow sampling protocol (purging and sampling at 100-500 ml/min) should be used if feasible. Other sampling methodologies may be approved for use by the DEQ if low-flow protocols are not feasible and if it can be demonstrated that they will be as effective in characterizing the parameters of concern as the low-flow methodology. If it is not feasible to collect samples that have turbidity that is representative of the water flowing in the aquifer, filtering may be appropriate for inorganic constituents. In such cases, both filtered and unfiltered samples should be collected for inorganic analysis. In most instances, a 0.45-micron filter will be appropriate, although site-specific circumstances may require larger filters to collect representative samples. Samples to be analyzed for organic substances should not be filtered regardless of sample turbidity.

- Monitoring plans should address the remaining items required in R299.5519(2)(a) to (l) of the Part 201 Rules. The items required in R299.5519(2)(a) to (l) include:
  - Location of monitoring points.
  - Environmental media to be monitored.
  - Monitoring schedule.
  - Monitoring methodology, including sample collection procedures (static groundwater and surface water elevations and groundwater quality should be monitored).
  - Substances to be monitored.
  - Laboratory methodology, including the name of the laboratory responsible for analysis of monitoring samples, method detection limits, and practical quantitation levels.
  - Quality control/quality assurance plan.
  - Data presentation and evaluation plan.
  - Contingency plan to address ineffective monitoring.
  - Operation and maintenance plan for monitoring.
  - An explanation of how the monitoring data will be used to demonstrate the effectiveness of the response activities.
  - Other elements required by the department to determine the adequacy of the monitoring plan.
- Monitoring plans should identify the conditions when no further monitoring is required.

2. Contingent Monitoring and Evaluation Plans

- Contingent monitoring plans should identify action(s) to be taken in the event that either the compliance monitoring or sentinel monitoring systems identify or predict exceedance of the relevant GSI criteria. At a minimum, this should address the following:
  - Reporting necessary.
  - Increased sampling frequency.
  - Installation of additional sampling points.
  - The process to evaluate the significance of the exceedance and the potential to impact human health, wildlife, or aquatic life.

Any exceedances of final acute criteria should be immediately evaluated to determine their significance and potential to harm aquatic life and to determine if any further remedial action is needed.

3. Contingent Remedial Action Plans

- Contingent remedial action plans should identify further remedial actions that will be taken when they are determined to be needed as a result of an evaluation of the significance of exceedances that are occurring or predicted to occur.
- Contingent remedial action plans should identify who will be responsible for taking the further remedial action and the time frame in which action will be taken.

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

INTEROFFICE COMMUNICATION

_____
[Date]

TO: Jim Pawloski, Acting Chief, Hydrologic Studies Unit
Water Management Section
Land and Water Management Division

FROM: Daniel Schultz, Field Coordinator
Environmental Response Division

SUBJECT: _____ [facility name]
Low-Flow Development Request

_____, County

We are requesting development of the following information for the above referenced facility:

[ ] - lowest monthly 95 percent exceedance flow rate
[ ] - harmonic mean flow
[ ] - recharge rate from precipitation
[ ] - 90dQ10 flow

We are providing the following information to assist in development of this information. Please complete the second page of this request and return it to the indicated Environmental Response Division District Supervisor or Unit Chief.

Priority: 1 [ ] (2 week response) 2 [ ] (4 week response)

Project Manager: _____ Phone #: _____

District Supervisor / Unit Chief: _____

Phone #: _____ FAX #: _____

1. Name of Surface Water Body:_____

2. Discharge location:_____1/4 of the _____ 1/4 of Section ____, T_____, R_____, of

_____ County

3. USGS Topographical Map Name: _____ Quadrangle
(map with location clearly marked is attached)

2. 4. Remarks:_____

_____

Attachment

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

INTEROFFICE COMMUNICATION

[Date]

TO: _____(Project Manager)
Environmental Response Division

FROM: Jim Pawloski, Acting Chief, Hydrologic Studies Unit
Land and Water Management Division

SUBJECT: _____[facility name]
Low-Flow Determination

LOW-FLOW DATA

1. Surface Water Body is: ____ Perennial ____ Intermittent ____ Ephemeral

2. Drainage Area: _____

3. Monthly 95 percent Exceedance Flows in cubic feet per second (CFS):

JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE

JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER

4. Lowest Monthly 95 percent Exceedance Flow: _____ CFS
5. Harmonic Mean Flow: _____ CFS
6. 90dQ10 Flow _____ CFS

7. Remarks: _____

_____

RECHARGE RATE FROM PRECIPITATION

1. The recharge rate from precipitation at this location is estimated to be _____ inches per year.

2. Remarks: _____

_____

_____ _____ _____
Hydrologic Studies Unit Supervisor Date LWMD Record Number

cc: Daniel Schultz, ERD

ERD Interim Operational Memorandum # 17 September 8,
1998 Attachment F, page 3 of 2

_____ (district supervisor or unit chief), ERD
Bill Creal / Jerry Saalfeld, SWQD

ATTACHMENT 5
MUSKEGON CHEMICAL MIXING ZONE DETERMINATION
REQUEST AND RESPONSE

CH2M HILL
135 South 84th Street
Suite 325
Milwaukee, WI
53214
Tel 414.272.2426
Fax 414.272.4408

CH2MHILL

December 03, 2001

103926.A3.01

Robert Franks
Michigan Department of Environmental Quality
ERD-Superfund
Knapps Center--Mezzanine Level
300 South Washington
Lansing, Michigan 48933

Subject: Mixing Zone Determination Request
Muskegon Chemical Company NPL Site

Dear Rob:

As discussed in your telephone conversation with Mike Brom on 30 November, Koch is re-submitting the Request for Mixing Zone Determination for the residual plume that would potentially discharge to Mill Pond Creek following shutdown of the Fruitland Township property groundwater extraction system. Per your request, we have used actual measured values (collected 05 Nov 2001) to calculate hydraulic gradients in the MPC area. The resulting gradients are steeper that in the original submittal resulting in a slightly higher plume discharge rate but there will still be a substantial amount of dilution from the creek.

The attached memorandum provides all of the information specified in Operational Memorandum 17 and should hopefully facilitate the review process. As we've discussed, Koch hopes to shutdown the system at the end of 2001, so an expedited review of this submittal by SWQD and ERD staff would be appreciated.

If you have any questions on this submittal please call or email Mike Brom or me at your convenience.

Sincerely,

CH2M HILL,

Mark L. Hinchey, P.G.
Senior Hydrogeologist

mke\Document2
c: Mike Brom/Reiss Remediation
Y.A. Demirjian/NSI

MEMORANDUM **CH2MHILL**

Request for Mixing Zone Determination--Fruitland Township Property Muskegon Chemical Company NPL Site

TO: Rob Franks

COPIES: Mike Brom/Reiss
John Lowe/CH2M HILL
Y.A. Demirjian/NSI

FROM: Mark L. Hinchey

DATE: October 9, 2001

Introduction

Groundwater extraction in the Mill Pond Creek area has removed contamination to below the GSI values for all COCs. Koch is preparing to shutdown the groundwater remediation system by the end of 2001. It is anticipated that very low concentrations of the six specific MCC signature compounds may continue to discharge to the creek following shutdown but none are expected to exceed the GSI. However, the GSI for one of these compounds (bis(2-chloroethyl)ether) is extremely low (15 µg/L). Because of this and Koch's desire not to have to reactivate the system should routine monitoring show a slight exceedence in compliance monitoring wells, Koch is pursuing a mixing zone determination for the MCC signature compounds.

Facility Location

The MCC facility is located in NW ¼ of the SW ¼ of Sec. 34, T. 12 N., R. 17 W. in the City of Whitehall, Muskegon County. The facility is the source of a contaminant plume remnant that discharges to Mill Pond Creek about ½ mile south west of the facility (Figure 1-1).

Facility Characteristics

Muskegon Chemical Company (MCC) manufactured specialty chemicals from 1976 until the plant was closed in 1991. Groundwater contamination was discovered at the facility in 1979 which triggered several stages of investigation and response actions. By 1981, the plume had extended to Mill Pond Creek and efforts at groundwater extraction and treatment were increased. The facility was acquired by Koch Chemical Company in 1985. The facility was placed on the NPL in 1990 and further remedial actions implemented. This resulted in the plume being completely intercepted and cut off from discharging to Mill Pond Creek by early 1993. Groundwater extraction has removed most of the contaminant mass and has reached the limits of its effectiveness. Consequently the Koch is preparing to

petition ERD for system shutdown. It is expected that very low concentrations of contaminants will discharge to the creek following shut down and into for the foreseeable future.

The receiving stream is Mill Pond Creek, a perennial stream draining an area of about 1.8 square miles. The plume vents to the creek on undeveloped property in Fruitland Township located in the NW ¼ of the NE ¼ of Sec. 4, T. 11 N., R. 17 W. (Figure 1) The property is owned by Koch Chemical Company, same owner as the facility. Following shutdown the discharge could be considered a new loading since contaminants have not vented to the creek since 1993.

Chemicals of Concern

Chemicals of concern are listed in the following table. All are moderately mobile in groundwater as evidenced by the fact that they were detected in Mill Pond Creek approximately 3 years after the suspected released date.

Chemical	CASRN	Predicted Worst Case Maximum GSI Discharge Concentration	Average Surface Water Concentration Upstream if Available
1,2-Dichloroethane (1,2-DCA)	107062	905	< 1 µg/L
Tetrachloroethene (PCE)	127184	2	< 1 µg/L
Trichloroethene (TCE)	79016	2	< 1 µg/L
Chlorobenzene (CBZ)	108907	7	< 1 µg/L
bis(2-Chloroethyl)ether (CLX)	111444	105	< 1 µg/L
bis(2-Chloroethoxy)ethane (TGDC)	111265	1500	< 1 µg/L

1,2-DCA, PCE, TCE and CBZ are volatile organic chemicals(VOCs) and are expected to dissipate rapidly through volatilization with half-lives ranging from several hours to several days. CLX and TGDC are semi-volatile compounds and are expected to degrade through hydrolysis within the same time frame as the VOCs.

None of these six compounds are bioaccumulative as indicated by their low octanol/water partition coefficients.

None of these compounds have been detected in any surface water samples collected from Mill Pond Creek in more than 10 years. They have never been detected in up stream surface water samples at this site.

Non aqueous phase liquids (NAPLs) have never been observed at this site nor do historic concentrations suggest the presence of NAPL.

Concentrations of these compounds in groundwater for the last 2 years are shown on Figures 3C and 3D. Concentrations have shown a steady decline over the period of record (dating from the early 1980s). However, due to the nature of the release (periodic discharge

to the floor drain system) concentrations in certain wells occasionally show an increase followed by an equally rapid decrease.

Mill Pond Creek Hydraulic Characteristics

Discharge data for Mill Pond Creek at Zellar Road (approximately 1100 feet downstream of the plume discharge point is provided on Exhibit 1. This information was provided by the Hydraulic Studies Unit of the land and water Management Division.

In addition to this information, stream gauging was also conducted in October 1991 during the CERCLA RI. Measurements were collected at two locations (Simonelli Rd ~ 1,500 ft upstream of plume discharge point where the reading was 1.4 cfs and at Zellar Rd, ~ 1100 ft. down stream of the plume discharge point where the flow was 9.7 cfs). Results confirm that Mill Pond creek is a gaining stream over this reach.

The Whitehall area receives about 30 inches of precipitation annually.

Discha:ge Rate of Venting Plume

Hydrogeologic Conceptual Model

The area is close to Lake Michigan, and the topography and geology are consistent with the glacial and lacustrine (lake) depositional environments and history of the area. Most of the soils are sandy and reach depths of up to 200 feet in some areas. Discontinuous clays form locally confining units. The water table ranges from 40 feet below ground surface near the plant to zero feet at local surface water bodies. The general direction of groundwater flow from the site is to the southwest toward Mill Pond Creek, located about 0.5 mile to the south. The results of the Remedial Investigation (RI) indicate that Mill Pond Creek is the local discharge area for groundwater from the site. More detailed information on physical characteristics of the site are provided in the RI report (CH2M HILL, 1995a). The hydrogeologic conceptual model is shown schematically on Figure H-3.

Since aggressive groundwater extraction began in 1996, the dimensions of the plume have contracted substantially leaving only a few isolated areas as shown in Figure 2 from the most recent quarterly progress report.

Discharge Rate of Venting Plume

Discharge rate calculations for the plume venting to Mill Pond Creek Calculations are provided in Exhibit 2. Given current dimensions (which are expected to decrease in the future) the estimated discharge rate of the plume is 0.005 cfs.

Location of Other Contaminant Plumes Entering the Receiving Surface Water Body, Their Constituents, and Concentrations

There are no other plumes venting to Mill Pond Creek.

Antidegradation Demonstration

Mill Pond Creek is not used as a source of water supply for any residential, commercial or industrial purposes. It is not known to be used for any recreational purposes, including

fishing. Mill Pond Creek is a gaining stream and discharges to White Lake approximately one mile from where the plume discharges to the creek. Surface water samples were collected from the creek in 1991 during the RI at locations down stream of the plume discharge area. This was 2 years before the plume was cut off and when the plume was much wider and chemical concentrations in groundwater were orders of magnitude higher than at present. Analytical testing then did not indicate the presence of any synthetic chemicals in surface water samples.

Concentrations in future, following shutdown, are expected to be generally below the GSI with the remote possibility of an occasional, short duration exceedence. Future discharges are not expected to degrade the quality of water in the creek nor prevent it from being used for the purposes to which it is suited.

Discharge of Bioaccumulative Chemicals of Concern (BCCs)

Not applicable. There are no BCCs in groundwater at this site.

Attachments

Exhibit 1

Exhibit 2

Figures

Exhibits 1 & 2

Exhibit 1

LOCATION FOR LOW FLOW DEVELOPMENT

Water Course: MILL POND CREEK

Location: AT ZELLAR ROAD

SW ¼ **of the** SE ¼ **of Section** 33 . **Town:** 12N. **Range:** 17W. MUSKEGON **county.**

USGS Topographical Map Name: Q17NE, MONTAGUE **Quadrangle**

LOW FLOW DATA

Drainage Area: 1.8 square miles

Monthly Exceedance and Mean Flows in CFS:

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
95%	0.9	0.9	1.2	1.4	0.8	0.4

	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
95%	0.3	0.3	0.3	0.4	0.5	0.7

90dQ10 Flow in CFS: 0.4

Harmonic Mean Flow in CFS: 1

MWL for RCS	1/22/01	4383
Hydrology Unit Supervisor	**Date Complete**	**HSU Record Number**

Exhibit 2
Mill Pond Creek Area Plume Discharge Calculations
Muskegon Chemical Company NPL Site
Mixing Zone Determination Request

$Q_p = KiA_p$ where,
Q_p = groundwater flux at groundwater--surface water interface; $[L^3/T]$
i = horizontal hydraulic gradient [L/L] = $[h_2 - h_1]/[L_2 - L_1]$
K = horizontal hydraulic conductivity [L/T]
A_p = cross sectional area of plume at groundwater surface water interface $[L^2]$

1. Calculate hydraulic gradient (I)

h_2	h_1	L
Elevation head at MWX 3-2, 05 Nov 2001 (ft, amsl)	Est. Elevation head at MPC, 05 Nov 2001 (ft, amsl)	Distance between h_2 and h_1 (ft)
605.52	599.05	350

I = 0.0113

$$\frac{605.52 - 599.05}{350} = \mathbf{0.0185}$$

2. Horizontal Hydraulic Conductivity (K_h) 1.7 x 10^{-2} cm/sec **= 5.6 x 10^{-4} ft/sec** **(Source:** *Remedial Investigation Report;* CH2M HILL, 1995)
K_h = 0.00056 ft/sec

3. Calculate area of plume discharge face = Plume width x Plume depth
Plume width: ~ 75 ft based on data from the last 2 years. Ref: *42nd Quarterly Progress Report*, CH2M HILL, 2001)
A_p = 750 ft^2 Plume depth: ~ 10 based on data from last 2 years Ref: *42nd Quarterly Progress Report*, CH2M HILL, 2001)
See figures and cross sections in main mixing zone request

4. Calculate Q_p

K	I	A_p		
0.00056 (ft/sec)	0.0185 (ft/ft)	750 (ft^2)	=	**0.008 (ft^3/sec)**

Q_p = KiA =
Q_p = 0.005 cfs

Mean Harmonic Flow MPC (ft^3/sec)=	1
90dQ_{10} (ft^3/sec)	0.4
Ratio Harmonic Mean Flow/Q_p =	**129**
Ratio 90dQ_{10}/Q_p =	**52**

Calculate Max Concentrations of COCs in GSI Compliance Wells That Will Not Exceed GSI Following Mixing

$$C_r = \frac{(C_p \times Q_p) + (C_s \times Q_s)}{Q_r}$$

$$C_p = \frac{(C_r \times Q_r) - (C_s \times Q_s)}{Q_p}$$

where ;

C_r = Concentration of the COC in the receiving stream following plume discharge = GSI (ug/L)
C_p = Concentration of COC in the venting plume (ug/L) = conc. In GSI compliance well
C_s = Concentration of analyte in the receiving stream (ug/L)
Q_p = discharge of the venting plume (cfs)
Q_s = flow of the receiving stream at the point of plume discharge (cfs)
Q_r = combined flow of stream and venting plume = $(Q_p + Q_s)$

For Harmonic Mean Flow

COC	C_r (ug/L)	Q_p (cfs)	Q_s (cfs)	Q_r (cfs)	$(C_r \times Q_r)$	C_s (ug/L)[1]	$(C_s \times Q_s)$	C_p (ug/L)
1,2-DCA	560	0.008	1	1.008	564	0.5	0.5	**72,623**
CLX	15	0.008	1	1.008	15	0.5	0.5	**1,883**
TGDC	500	0.008	1	1.008	504	0.5	0.5	**64,835**

For $90dQ_{10}$

COC	C_r (ug/L)	Q_p (cfs)	Q_s (cfs)	Q_r (cfs)	$(C_r \times Q_r)$	C_s (ug/L)[1]	$(C_s \times Q_s)$	C_p (ug/L)
1,2-DCA	560	0.008	0.4	0.408	228	0.5	0.2	**29,385**
CLX	15	0.008	0.4	0.408	6	0.5	0.2	**762**
TGDC	500	0.008	0.4	0.408	204	0.5	0.2	**26,234**

[1] COCs have not been detected in upstream samples collected from Mill Pond Creek In instances where a compound is not detected, it is customary to use 1/2 of the detection limit as a representative concentration The detection limit is 1ug/L.

Calculate Concentrations of MCC COCs in Mill Pond creek

$$C_r = \frac{(C_p \times Q_p) + (C_s \times Q_s)}{(Q_s + Q_p)}$$

where ;

C_r = Concentration of the COC in the receiving stream following plume discharge (ug/L)
C_p = Concentration of COC in the venting plume (ug/L)
C_s = Concentration of analyte in the receiving stream (ug/L)
Q_p = discharge of the venting plume (cfs)
Q_s = flow of the receiving stream at the point of plume discharge (cfs)

For Harmonic Mean Flow

COC	C_p (ug/L)	Q_p (cfs)	$(C_p \times Q_p)$	C_s (ug/L)	Q_s (cfs)	$(C_s \times Q_s)$	$(Q_s + Q_p)$
1,2-DCA	905	0.008	7.03	0.5	1	0.5	1.008
CLX	105	0.008	0.82	0.5	1	0.5	1.008
TGDC	1500	0.008	11.65	0.5	1	0.5	1.008

$$C_r = \frac{(C_p \times Q_p) + (C_s \times Q_s)}{(Q_s + Q_p)} =$$

COC	C_r	GSI	Ratio
1,2-DCA	**7.5**	560	0.01
CLX	**1.3**	15	0.09
TGDC	**12.1**	500	0.02

For 90dQ10

COC	C_p (ug/L)	Q_p (cfs)	$(C_p \times Q_p)$	C_s (ug/L)	Q_s (cfs)	$(C_s \times Q_s)$	$(Q_s + Q_p)$
1,2-DCA	905	0.008	7.03	0.5	0.4	0.2	0.408
CLX	105	0.008	0.82	0.5	0.4	0.2	0.408
TGDC	1500	0.008	11.65	0.5	0.4	0.2	0.408

$$C_r = \frac{(C_p \times Q_p) + (C_s \times Q_s)}{Qs + Qp} =$$

COC	C_r	GSI	Ratio
1,2-DCA	**17.7**	560	0.03
CLX	**2.5**	15	0.17
TGDC	**29.1**	500	0.06

Figures

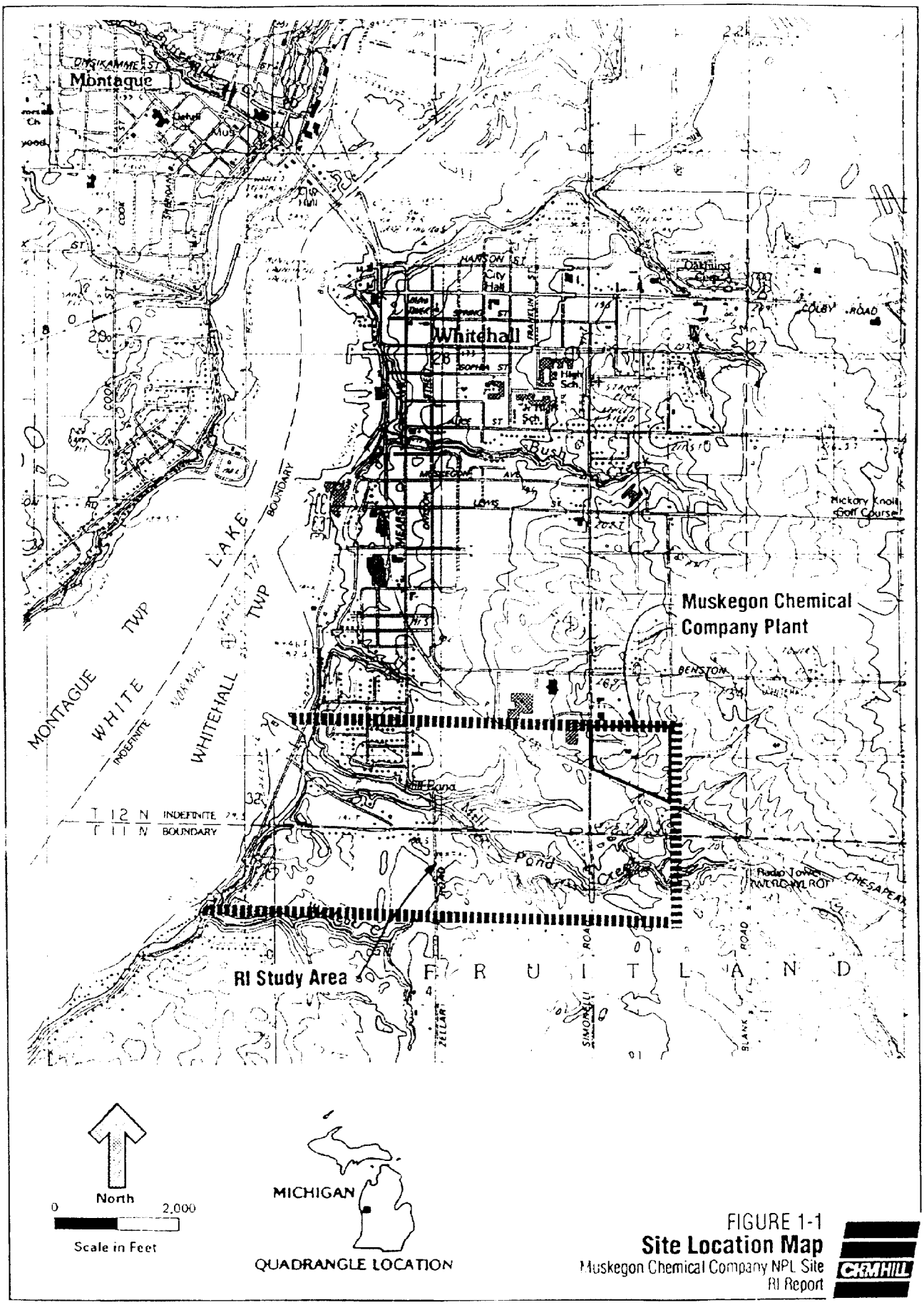


FIGURE 1-1
Site Location Map
Muskegon Chemical Company NPL Site
RI Report

CRMHILL

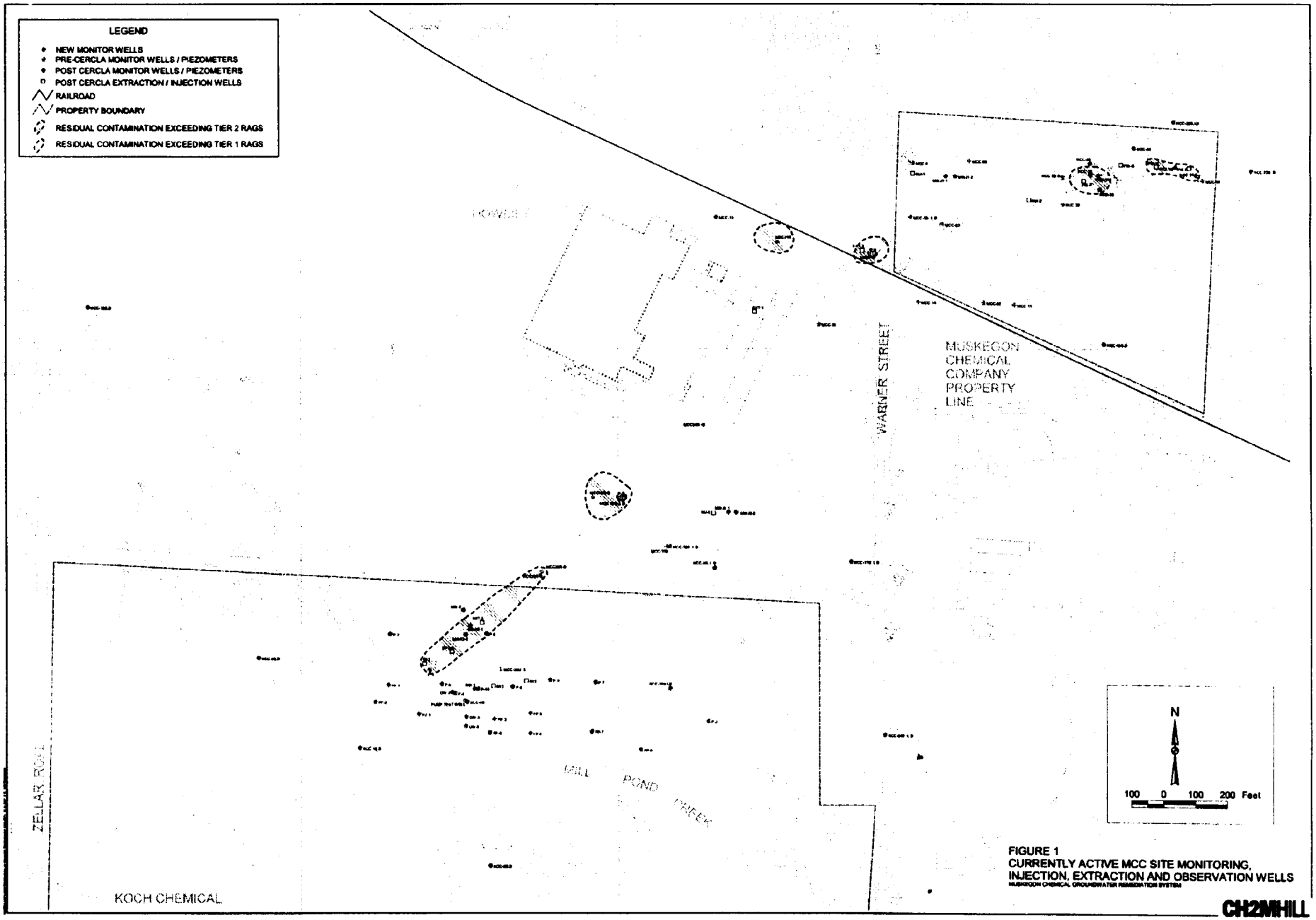


FIGURE 1
CURRENTLY ACTIVE MCC SITE MONITORING, INJECTION, EXTRACTION AND OBSERVATION WELLS
MUSKEGON CHEMICAL GROUNDWATER REMEDIATION SYSTEM

CH2MHILL

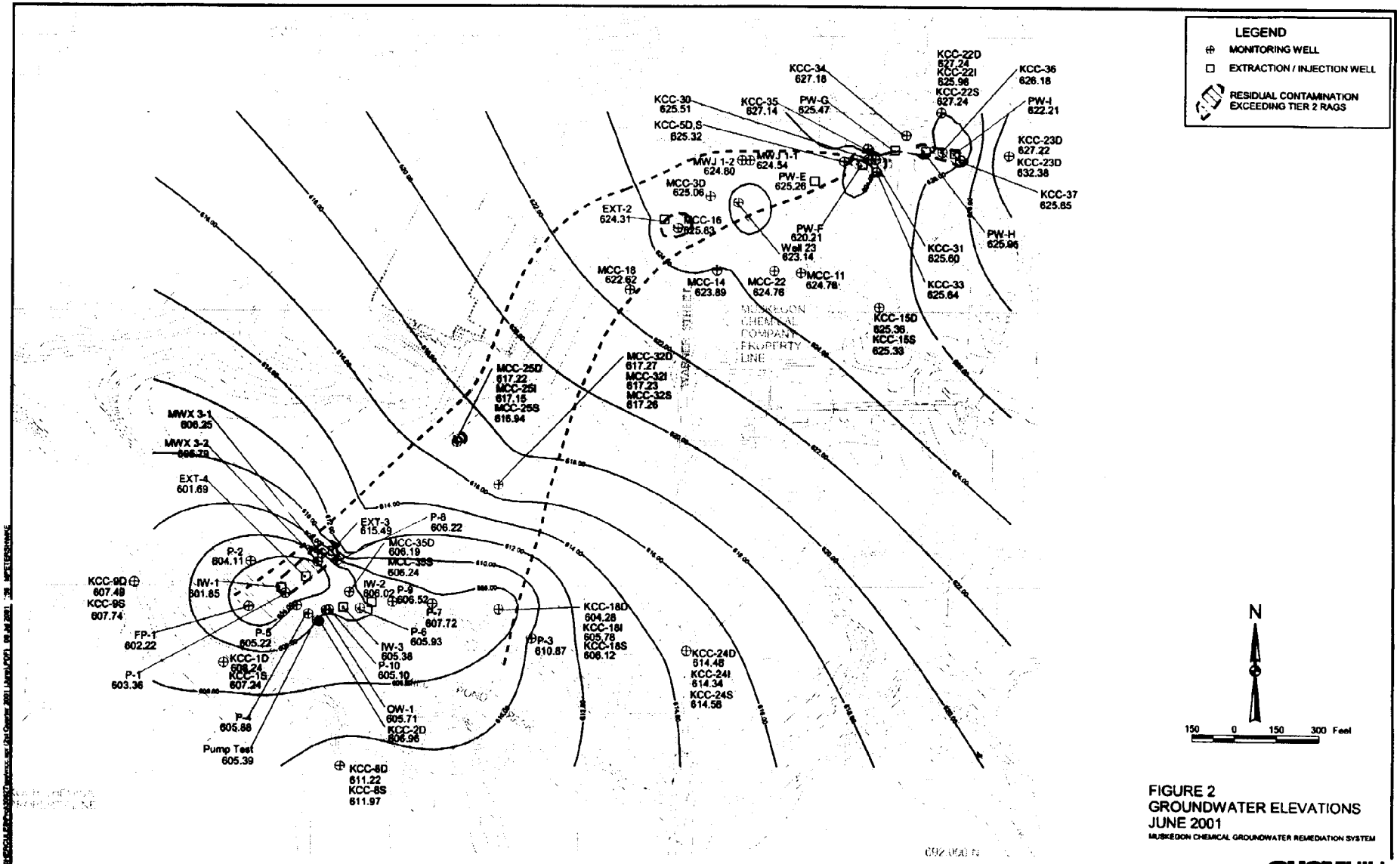
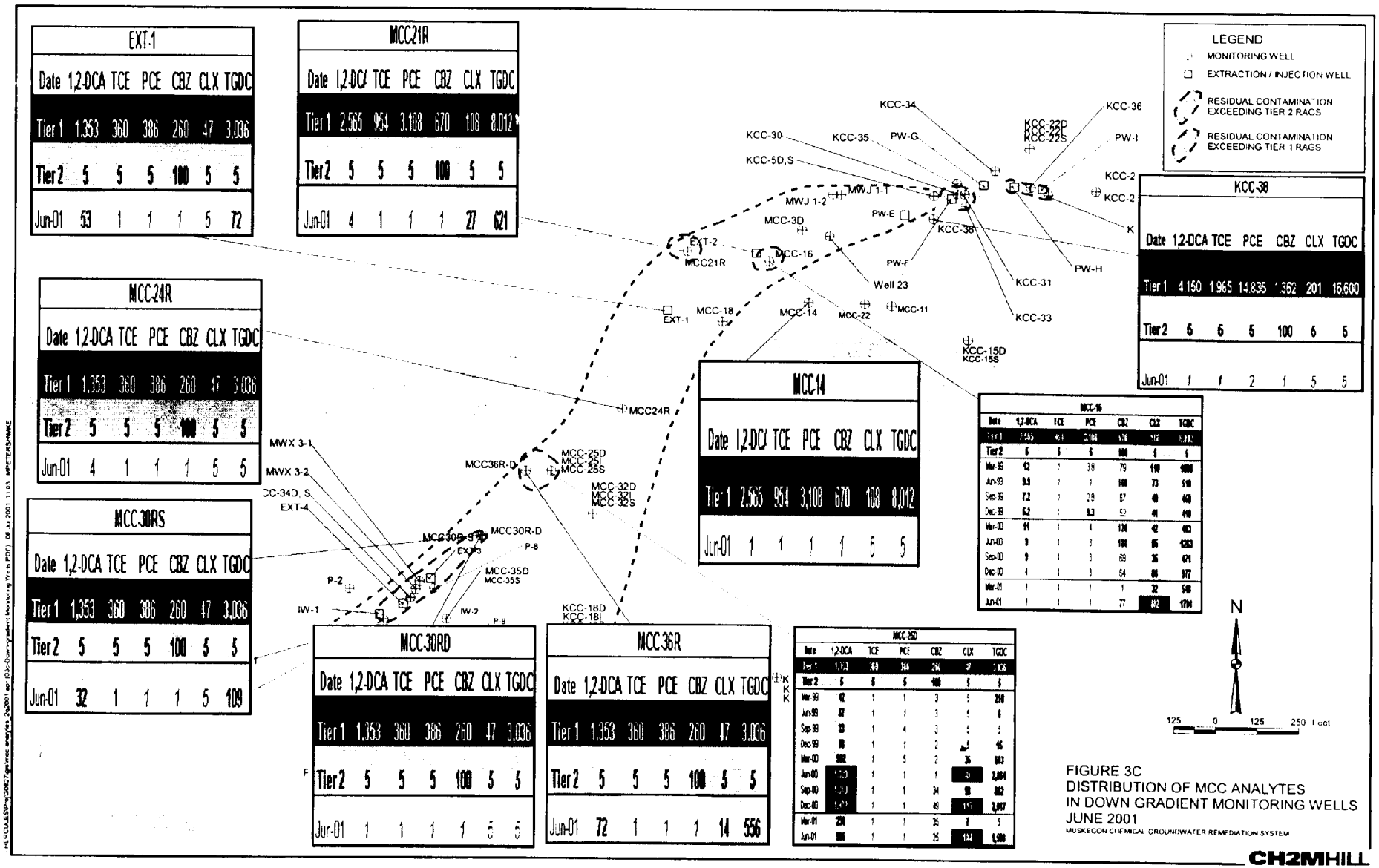
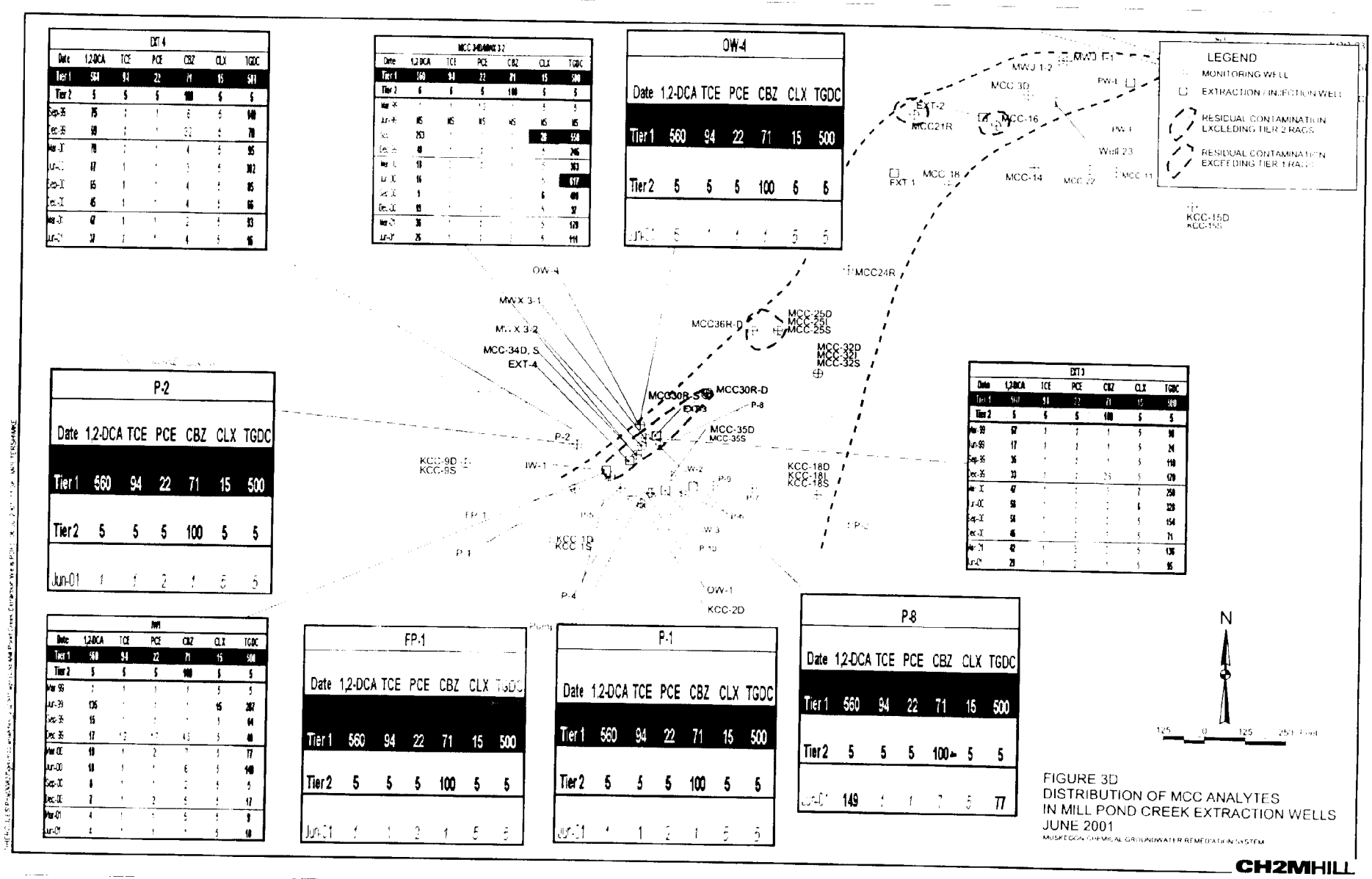


FIGURE 2
GROUNDWATER ELEVATIONS
JUNE 2001
MUSKEGON CHEMICAL GROUNDWATER REMEDIATION SYSTEM

CH2MHILL


EXT-1
Date 1,2-DCA TCE PCE CBZ CLX TGDC
Tier 1 1,353 360 386 260 47 3,036
Tier 2 5 5 5 100 5 5
Jun-01 53 1 1 1 5 72
MCC21R
Date 1,2-DCA TCE PCE CBZ CLX TGDC
Tier 1 2,565 954 3,108 670 108 8,012
Tier 2 5 5 5 100 5 5
Jun-01 4 1 1 1 27 621
MCC24R
Date 1,2-DCA TCE PCE CBZ CLX TGDC
Tier 1 1,353 360 386 260 47 3,036
Tier 2 5 5 5 100 5 5
Jun-01 4 1 1 1 5 5
MCC30RS
Date 1,2-DCA TCE PCE CBZ CLX TGDC
Tier 1 1,353 360 386 260 47 3,036
Tier 2 5 5 5 100 5 5
Jun-01 32 1 1 1 5 109
MCC30RD
Date 1,2-DCA TCE PCE CBZ CLX TGDC
Tier 1 1,353 360 386 260 47 3,036
Tier 2 5 5 5 100 5 5
Jun-01 1 1 1 1 5 5
MCC36R
Date 1,2-DCA TCE PCE CBZ CLX TGDC
Tier 1 1,353 360 386 260 47 3,036
Tier 2 5 5 5 100 5 5
Jun-01 72 1 1 1 14 556
MCC14
Date 1,2-DCA TCE PCE CBZ CLX TGDC
Tier 1 2,565 954 3,108 670 108 8,012
Jun-01 1 1 1 1 5 5
KCC-38
Date 1,2-DCA TCE PCE CBZ CLX TGDC
Tier 1 4,150 1,965 14,835 1,362 201 16,600
Tier 2 5 5 5 100 5 5
Jun-01 1 1 2 1 5 5
LEGEND
MONITORING WELL
EXTRACTION / INJECTION WELL
RESIDUAL CONTAMINATION EXCEEDING TIER 2 RAGS
RESIDUAL CONTAMINATION EXCEEDING TIER 1 RAGS
KCC-34
KCC-36
KCC-30
KCC-35
PW-G
KCC-32P
KCC-32S
PW-I
KCC-5D,S
KCC-2
KCC-2
MWJ 1-2
MWJ 1-T
PW-E
MCC-3D
KCC-38
K
EXT-2
MCC21R
MCC-16
PW-F
PW-H
Well 23
KCC-31
EXT-1
MCC-18
MCC-14
MCC-22
MCC-11
KCC-33
KCC-15D
KCC-15S
MCC24R
MWX 3-1
MWX 3-2
MCC36R-D
MCC-25D
MCC-25I
MCC-25S
MCC-32D
MCC-32I
MCC-32S
EXT-4
MCC30R-S
MCC30R-D
P-8
EXT-3
MCC-35D
MCC-35S
P-2
IW-1
IW-2
P-9
KCC-18D
KCC-18I
N
125 0 125 250 Feet
FIGURE 3C
DISTRIBUTION OF MCC ANALYTES
IN DOWN GRADIENT MONITORING WELLS
JUNE 2001
MUSKEGON CHEMICAL GROUNDWATER REMEDIATION SYSTEM
CH2MHILL



Date	1,2-DCA	TCE	PCE	CBZ	CLX	TGDC
Tier 1	560	94	22	71	15	500
Tier 2	5	5	5	100	5	5
Jun-01	1	1	2	1	5	5

Date	1,2-DCA	TCE	PCE	CBZ	CLX	TGDC
Tier 1	560	94	22	71	15	500
Tier 2	5	5	5	100	5	5
Jun-01	1	1	2	1	5	5

Date	1,2-DCA	TCE	PCE	CBZ	CLX	TGDC
Tier 1	560	94	22	71	15	500
Tier 2	5	5	5	100	5	5
Jun-01	149	1	1	2	5	77

Date	1,2-DCA	TCE	PCE	CBZ	CLX	TGDC
Tier 1	560	94	22	71	15	500
Tier 2	5	5	5	100	5	5
Jun-01	1	1	2	1	5	5

Date	1,2-DCA	TCE	PCE	CBZ	CLX	TGDC
Tier 1	560	94	22	71	15	500
Tier 2	5	5	5	100	5	5
Jun-01	1	1	2	1	5	5

FIGURE 3D
DISTRIBUTION OF MCC ANALYTES
IN MILL POND CREEK EXTRACTION WELLS
JUNE 2001
MUSKEGON CHEMICAL GROUNDWATER REMEDIATION SYSTEM

CH2MHILL

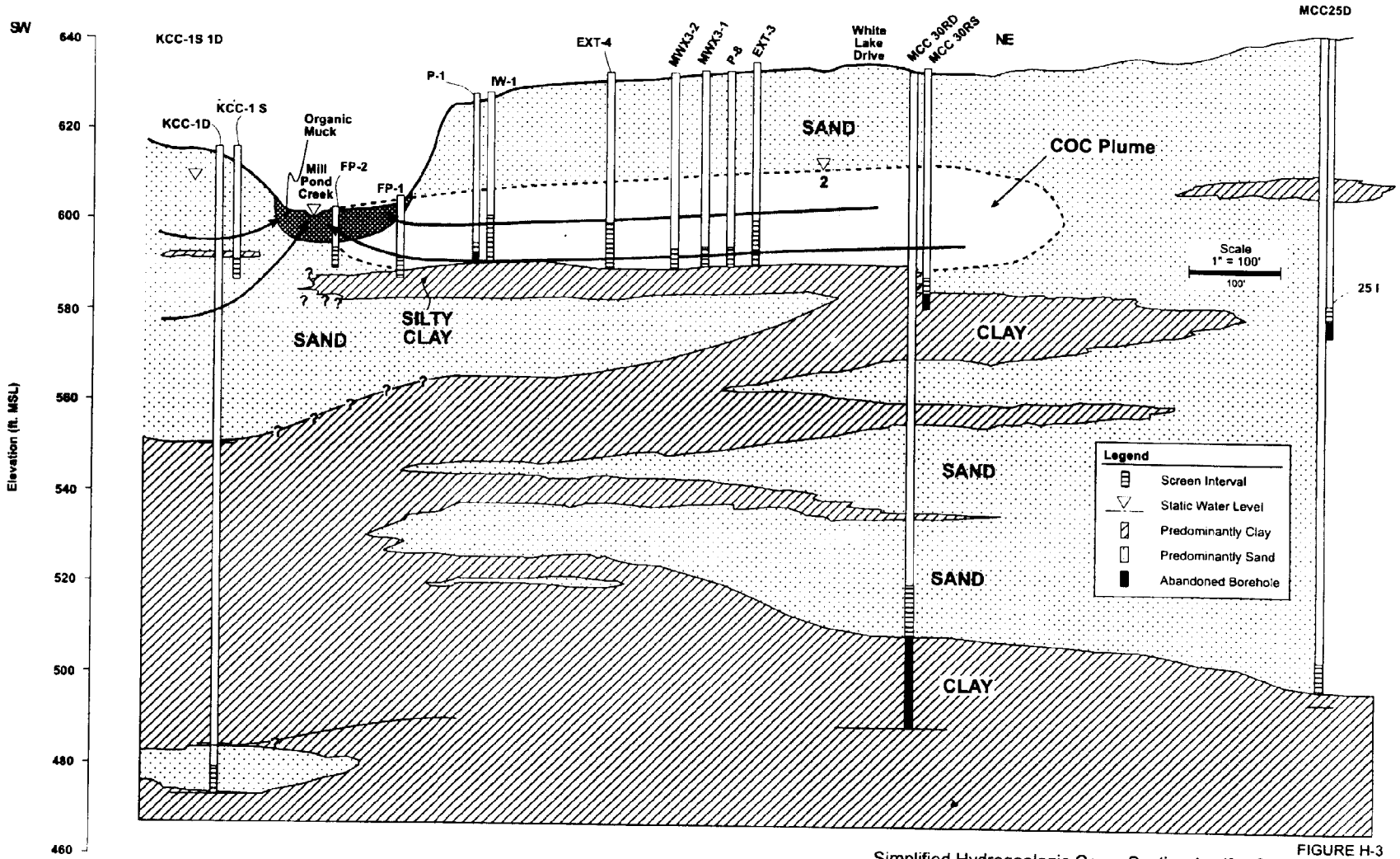


FIGURE H-3
Simplified Hydrogeologic Cross-Section Aquifer Characterization
Muskegon Chemical Company (MCC) NPL Site
RI Report

CH2MHILL

From: Sarah Walsh
To: Patricia Brandt; Robert Franks
Date: Mon, May 20, 2002 9:02 AM
Subject: Muskegon Chemical

Based on the Mill Pond Creek Surface Water and Sediment Sampling Results submitted by Mark Hinchey on March 27, 2002 we agree to remove Mill Pond Creek from the nonattainment list. The current listing of Mill Pond Creek will be formally removed next time the list is updated. Surface water and sediment data collected in March 2002 reported nondetectable levels of all chemicals noted in the Muskegon Chemical Company groundwater contaminated plume discharge. These data along with surface water samples collected in 1991, 1993, 1994, and 1996 and sediment data collected in 1991, 1992, and 1994 indicate that the surface water concentrations have been below detection level since the extraction system was activated and the concentrations in the sediment have declined to nondetectable levels.

In addition, we recommend that you approve the antidegradation demonstration submitted on March 14th, 2002 by Mark Hinchey of CH2M HILL.

We provided you with following acute and chronic limits in February:

Chemical	Acute Limit, ug/l (lbs/d)	Chronic Limit, ug/l (lbs/d)
1,2-Dichloroethane	15000 (.40)	- - -
Tetrachloroethylene	710 (.02)	- - -
Trichloroethylene	3500 (.09)	3200 (.09)
Chlorobenzene	850 (.02)	750 (.02)
Bis(2-Chloroethyl)ether	18000 (.48)	770 (.02)
bis(2-Chloroethoxy)ethane	**26000 (0.70)**	**23000 (0.62)**

Note: we were missing Rule 57 water quality data on bis(2-Chloroethoxy)ethane in the original note with acute and chronic limit data.

Let me know you have any questions.
Sarah